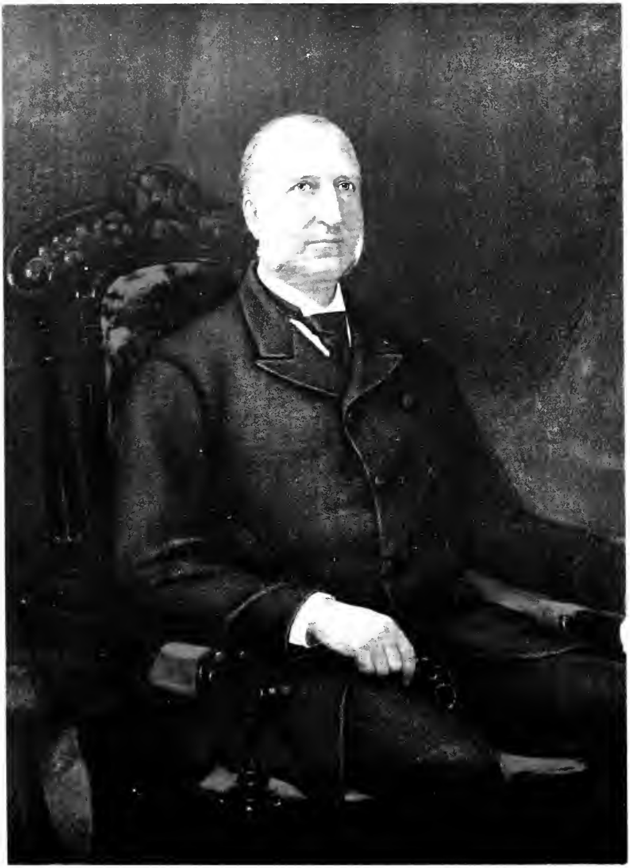
ONE HUNDRED YEARS OF AMERICAN COMMERCE



Chauncey M. Depew.

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1795-1895

ONE HUNDRED YEARS OF AMERICAN COMMERCE

CONSISTING OF

ONE HUNDRED ORIGINAL ARTICLES ON COMMERCIAL TOPICS DESCRIBING THE PRACTICAL DEVELOPMENT OF THE VARIOUS BRANCHES OF TRADE IN THE UNITED STATES WITHIN THE PAST CENTURY AND SHOWING THE PRESENT MAGNITUDE OF OUR FINANCIAL AND COMMERCIAL INSTITUTIONS

A History of American Commerce by One Hundred Americans

WITH A

CHRONOLOGICAL TABLE

OF THE IMPORTANT EVENTS OF AMERICAN COMMERCE AND INVENTION WITHIN THE PAST ONE HUNDRED YEARS

EDITED BY

CHAUNCEY M. DEPEW, LL.D.

ISSUED IN COMMEMORATION OF THE COMPLETION OF THE FIRST CENTURY OF AMERICAN COMMERCIAL PROGRESS AS INAUGURATED BY THE TREATY OF AMITY, COMMERCE, AND NAVIGATION NEGOTIATED BY CHIEF JUSTICE JAY AND APPROVED BY PRESIDENT WASHINGTON IN 1795

IN TWO VOLUMES

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CONTENTS

VOLUME I

VOLUME II

ILLUSTRATIONS

VOLUME I

CHIEF-JUSTICE JOHN JAY. Frontispiece

VOLUME II

CHAUNCEY M. DEPEW, LL. D. Frontispiece

ONE HUNDRED YEARS OF
AMERICAN COMMERCE

CHAPTER XLVIII

LOCOMOTIVE AND ENGINE WORKS

ALTHOUGH transportation for self or chattels has long been known to man, improvement in its various methods was so slow as to be almost imperceptible until the introduction of steam gave it an impetus on land and water. This powerful agent has been adapted to transportation within the past one hundred years, and the event has been followed by the decline and fall of the stage-coach and the canal-boat, and the rise and development of the locomotive and the steamship. These two have constituted the most important factors of transportation, which is itself one of the most important elements of the civilization of the present century. On sea and land rapid transportation was impossible without steam. This was applied first to power transmission, as in pumping and the movement of machinery; then to navigation, where the conditions correspond most nearly to those of stationary practice, and last to the propulsion of vehicles on land. The factor by which its power is utilized for the latter purpose is the locomotive. There are no branches of the mechanic arts which possess greater fascination for the general public than the building of steamships and locomotives. Properly directed, they struggle, they accomplish, they excel; and all are interested in their achievements. This interest is not new. It attached no less to the transportation of bygone generations. The rivalry of competing stage-coaches and the popularity of the favorite whips are traditional. To-day the master of the speediest steamship and the driver of the fastest locomotive have inherited the same popular regard.

As the entire development of locomotive engineering in the United States has taken place within the past century, it is not difficult to trace its inception and progress. Although other lines of rails had previously been laid for special purposes, the Baltimore and Ohio and the South Carolina railroads — both begun in 1828 — were the first American railways constructed to carry passengers and freight. Upon the first mentioned of these lines was run the first American-built locomotive,— that of Peter Cooper, which was constructed in 1829. This was, however, a mere working model, not intended for permanent service, but to demonstrate the practicability of operating the line by locomotive power. It did this successfully, and led to the completion of the road, which otherwise might have been abandoned. This little machine, with a single cylinder three and a half inches in diameter, a boiler no larger than that of an ordinary kitchen-range, and tubes improvised from gun barrels, on its trial run attained a speed of eighteen miles an hour, and hauled forty passengers besides the driver, who was Peter Cooper himself. The first locomotive for real service used in the United States was the "Stourbridge Lion," built at Stourbridge, England, and imported by Horatio Allen, in 1829, for the Delaware and Hudson Canal Company. It was of a primitive type, quickly abandoned both in England and the United States, but forms one of the interesting steps by which a uniform pattern was subsequently reached. In 1830, the first locomotive constructed in the United States for actual work — the "Best Friend" — was built by the West Point Foundry, for the South Carolina Railroad. In 1831 Matthias W. Baldwin, a manufacturer of bookbinders' tools, of Philadelphia, was engaged by the proprietors of Peale's Museum, of Philadelphia, to construct a model locomotive to operate on a circular track, to satisfy the public curiosity growing out of the Rainhill contest, in England, which had resulted in a victory for Robert Stephenson's "Rocket," and which was then attracting widespread attention. In September, 1832, there were built at York, Pa., by Davis & Gartner, three locomotives of the "grasshopper" pattern, for the Baltimore and Ohio Railroad, from designs of Phineas

Davis and Ross Winans. Some of these locomotives continued in service about sixty years, and until recently were still in use at Mount Clare, in Baltimore.

The success of the Peale Museum model was such that Mr. Baldwin was employed by the Philadelphia, Germantown and Norristown Railroad Company, in 1831, to construct a locomotive for their line. This locomotive — "Old Ironsides"— was completed in November, 1832. It was a four-wheel engine, similar to the English design of the day, and weighed in running order something over five tons. The rear, or driving wheels, were fifty-four inches in diameter, placed on a crank axle. The cylinders were nine and one half inches in diameter, by eighteen inches stroke, and were attached horizontally to the smoke-box. The frame was of wood. The wheels were made with heavy cast-iron hubs, wooden spokes and rims, and wrought-iron tires. There was no cab. The tender was four-wheeled, with wooden sides and back for holding the wood used for fuel, and with an iron box used as a water-tank. This locomotive attained a speed of thirty miles an hour, with its train attached, and upon a special occasion it is said to have attained a speed of sixty miles per hour. Locomotive engine building may be said to have become fairly established by 1834; but in those early days, when there was no practice to guide, when skilled workmen were few, and but little in the way of shop facilities existed, the difficulties surrounding the locomotive builder were extraordinary, and only the most indomitable perseverance attained success. Civilization owes a debt of gratitude to those pioneers of railway mechanics—Cooper, Allen, Baldwin, Rogers, Norris, Winans, Campbell, and their co-workers, and later to William Mason, Cooke, McQueen, Millholland, Hudson, and others.

The early American locomotives were similar in all essential features to the English engines of the day, being constructed largely either from published descriptions or from actual observation of those imported. The importation of locomotives did not long continue, however, as the mechanics of the country soon proved their ability to supply the demands of the growing railroads. The many bright minds engaged upon the subject, together with active competition among the early builders, soon resulted in radical departures from the English types. Developing independently, under various conditions, the differentiation soon became marked, and resulted in features which still distinguish the American from the English locomotive, in whatsoever country they may be found. The steps by which these differences were reached may be briefly touched upon as follows: the substitution of a four-wheel swiveling truck or bogie for the pair of fixed carrying-wheels (1832); the use of the cross-head pump for supplying feed-water to the boiler (1833); the use of the half-crank driving-axle in place of the crank-axle (1834); the use of outside connections to the driving-wheels (1835); the coupling together of two pairs of driving-wheels, patented by H. R. Campbell (1836); the use of counterbalance weights to balance the revolving and reciprocating parts (1837); the use of lap-welded wrought-iron boiler tubes (1838); the use of bar-frames of forged iron with forged pedestals (1840); the use of wooden cabs with glass windows, to afford ample protection for the enginemen, which originated about 1840 in New England, where such protection was necessary on account of the severity of the winters; the introduction of Baldwin's flexible-beam truck (1842); the use of equalizing beams connecting the driving-wheels, invented by Eastwick and Harrison (1845); the use of the "ten-wheel" locomotive, with six coupled wheels and a leading four-wheel truck (1846); the use of the Mogul locomotive with six coupled wheels and a leading two-wheel truck (1861), and of the Consolidation type, with eight coupled wheels and a leading two-wheel truck, designed by Alexander Mitchell of the Lehigh Valley Railroad, and built at the Baldwin Locomotive Works in 1866. The Mogul type took its name from the first engine of this class; the Consolidation type likewise took its name from Mitchell's "Consolidation," but the latter was named not because of any peculiarity of design, but because of the then recent consolidation of a number of smaller lines now joined in the Lehigh Valley system.

Other features of the American locomotive appear to the foreigner to be peculiar, such as the pilot or "cowcatcher," the bell, the boiler covering of planished or Russia iron, the large headlight, and the directness and visibility of the pipes and other appurtenances. The aim of American locomotive designers has been to produce a machine having the maximum flexibility of wheel-base to enable it to pass sharp curvature and adapt itself to the unevenness of track subject to the action of severe frosts; and to provide for repairs by making every part accessible and removable without affecting other parts. Prior to the Centennial Exhibition of 1876, it was frequently customary to use gaudy painting and forms of unessential parts supposed to be ornamental; but during the period of business depression

and retrenchment in which the Centennial occurred, the railroads learned to dispense with this source of expense. This cause, together with the improvement in the public taste which was coincident with, or the result of, the Centennial, led to the abandonment of fancy painting and molded or beaded ornamentation, and the substitution of smooth, appropriate forms, painted in plain dark colors, with little or no striping.

In the early fifties the "American" type, with four coupled wheels and four-wheeled truck, patented by Campbell in 1836, became the most generally adopted class of locomotive, and was for many years thereafter used for general service — passenger, freight, and switching. The growing traffic of the railways, however, created the need for more powerful locomotives constructed especially for freight service, as well as for engines better adapted for switching than old road locomotives. Therefore, in the sixties, the Mogul and ten-wheel types were widely adopted, and between 1870 and 1880 the Consolidation type became the recognized standard for the heaviest freight service. Prior to 1880, the general use of iron tires and iron rails of light section, usually not exceeding fifty to sixty pounds per yard, limited the weight per axle to about twelve tons as a maximum. About that year the general substitution of steel tires and the growing use of steel and the introduction of the heavier rails possible in steel, together with an awakening to the advantages of larger heating surfaces in locomotive boilers, led to the acceptance of greatly increased weights. This tendency has since grown constantly. The use of heavier, more powerful locomotives made practicable economies in transportation by the use of cars of larger carrying capacity, which in turn required still heavier locomotives to move them. Like the perpetual contest between the impenetrable armor-plate and the irresistible projectile, it is difficult to predict the conclusion of the struggle. It appears, however, that the present car loads of 60,000 to 80,000 pounds are about as large as will serve the convenience of shippers. It is safe to predict that rails of 100 pounds per yard, which have already been adopted by a number of the most important lines, must shortly come into general use. The heaviest locomotives of 1895 have as much as twenty-four tons' weight per axle.

Among the locomotive-building establishments which have contributed a share to the motive-power of the past, and have either disappeared altogether or have discontinued the manufacture of locomotives for other lines of business in which competition is less intense, may be mentioned the works of Norris Brothers, of Philadelphia, which in early days were active competitors of Baldwin and Rogers, but which, after many vicissitudes, went out of existence in 1865. These works in part are now included in the plant of the Baldwin Locomotive Works. Baltimore had the works of Ross Winans and the Denmeads. Boston has had the works of Seth Wilmarth, the Globe Works of John Souther, and the works of McKay & Aldus at East Boston, whilst the Hinckley Locomotive & Machine Works, one of the oldest, occupied an honorable position in the business until within ten years. New England has been an active locomotive-building section. In addition to the works mentioned may be noted those of Ballard Vail, Andover, near Boston, Mass.; Corliss & Nighttingale, Providence, Geo. H. Corliss, the great engine-builder, proving less successful in the manufacture of locomotives; A. Latham & Company, White River Junction; the Amoskeag Locomotive Works at Manchester, N. H.; the Locks and Canals Works at Lowell, Mass.; a works at Lawrence; and in later days the Taunton Locomotive Works, the Mason Machine Works, and the Portland Locomotive and Car Company, three concerns of enviable reputation, which have recently found other lines of business more profitable. New Jersey also has been a prolific field of locomotive-manufacture. An offshoot from the Rogers Works was that of William Swinburne, of Paterson, which was subsequently called the New Jersey Locomotive Works, and finally the Grant Locomotive Works. Finding their shops antiquated and their appliances inadequate to modern requirements, the Grant Works ceased business at Paterson in 1885, and reorganized with new capital and new shops at Chicago. This plant succumbed to the financial storm of 1893, and was sold to the Siemens & Halske Electric Company, which now operates it under its own name for the manufacture of electrical equipment and locomotives. For many years Breese, Kneeland & Company operated the Jersey City Locomotive Works at Jersey City, and Van Cleeve, McKean & Dripps had shops at Trenton. Eastwick & Harrison were builders of locomotives at Newcastle, Delaware, but, failing in 1840, were succeeded by the Newcastle Manufacturing Company. The partners subsequently gained fame and wealth in railway operations in Russia. In the West were the Cuyahoga Works of Cleveland, those of Scovill at Chicago, Booth & Company at San Francisco, and others at Detroit and Milwaukee. Later the Rome Locomotive Works, at Rome, New

York, entered the field, but had only a few years of disastrous existence, which ended in 1891. The list might perhaps be extended further, but it is a more agreeable task to record the works which are, in this year 1895, engaged in keen but friendly rivalry to contribute to the progress of transportation and to supply the motive power for 180,000 miles of railways in the United States and a considerable number abroad.

The Baldwin Locomotive Works of Philadelphia were established in 1831 by Matthias W. Baldwin, as has before been mentioned. These works are now the property of George Burnham, Edward H. Williams, William P. Henszey, John H. Converse, and William L. Austin, partners, constituting the firm of Burnham, Williams & Company. The annual capacity is 1000 locomotives, and 947 have actually been constructed in a single year, during all of which, however, the demand for locomotives was not sufficient to keep the works running continuously to their maximum capacity. The works occupy sixteen acres in the center of the city. A number of the buildings of later construction are from four to six stories in height and of the most substantial character. Employment is given to about 5100 men.

The Rogers Locomotive Works, of Paterson, N. J., were founded in 1836 by the firm of Rogers, Ketchum & Grosvenor. The mechanical head and dominating spirit was Thomas Rogers. Upon his death in 1856 the business was incorporated under the title of The Rogers Locomotive and Machine Works, of which Jacob S. Rogers was president and William S. Hudson was superintendent. Mr. Hudson exercised an important influence upon the development of American locomotive manufacture. Owing to Mr. J. S. Rogers' increasing age, the company was reorganized in 1892 under its present title of The Rogers Locomotive Company. Mr. R. S. Hughes, for many years treasurer, became president, and Mr. Reuben Wells, well known for his honorable connection with railroad management, became superintendent. These works give employment to about 1400 men, and have an annual capacity of 250 locomotives.

The Schenectady Locomotive Works were established by Norris Brothers in 1848, were incorporated in 1851, and in 1863 passed into the sole control of John Ellis, who associated with him as superintendent Walter McQueen. Mr. Ellis was succeeded, upon his death in 1864, by his next younger brother, Charles G. Ellis, and upon the death of the latter in 1891 Edward Ellis became president. Mr. A. J. Pitkin is now superintendent. The works employ 1800 men and have an annual capacity of 400 locomotives.

The Cooke Locomotive and Machine Company, of Paterson, N. J., began the manufacture of locomotives in 1852, the title of its ownership then being Danforth, Cooke & Company. The works were originally established about the year 1800, and for fifty years were engaged in the manufacture of cotton and other machinery. Upon the entrance of John Cooke, who had previously been in the employment of Thomas Rogers, the manufacture of locomotives was begun. John Cooke may therefore be regarded as the founder of this establishment as a locomotive-works. The present organization is John S. Cooke, president; Frederick W. Cooke, vice-president; William Berdan, secretary and treasurer; and Charles D. Cooke, superintendent. The original shops in Paterson have recently been abandoned to other uses, and new and completely modern shops have been built with a capacity of 180 locomotives per year. The works employ about 800 men.

The Pittsburgh Locomotive Works were organized in August, 1865, and were completed so far as to construct their first locomotive in the latter part of 1866. The works were originally designed for a capacity of thirty locomotives per year, but by the construction of new fire-proof buildings, and the addition of new and improved machinery, the capacity has been gradually increased to 300 engines per year. The works occupy nearly twelve acres of ground, and their equipment includes the most improved hydraulic, pneumatic, and electric appliances for fashioning the work and handling materials. There is also a completely appointed laboratory for chemical and physical tests of materials. The works employ about 1500 men.

The Rhode Island Locomotive Works of Providence, Rhode Island, were likewise established in 1865, at the close of the War of the Rebellion, when the nation once more turned to the arts of peace and began the work of restoring its wasted energies, expanding its means of internal communication, and developing its material resources. These works have occupied an important position in the field of locomotive-manufacture. As now organized, Charles Felix Mason is president, Arthur Livingstone Mason is vice-president, Earl Philip Mason is secretary and treasurer, and Joseph Lythgoe is superintendent. These works employ about 1400 men, and have an annual capacity of 250 locomotives.

The works of H. K. Porter & Company, of Pitts-

Alba B. Johnson.

burgh, were established in 1869, and have been devoted exclusively to the manufacture of light locomotives for such special purposes as in mills, furnaces, mines, contractors' and plantation service, etc. The firm was at first Smith & Porter, and later Porter, Bell & Company. It employs 325 men, and has a capacity of 120 locomotives per annum.

The Brooks Locomotive Works of Dunkirk, New York, were originally constructed as the locomotive building and repair shops of the Erie Railway. In 1869, Jay Gould, then president of the Erie Railway, having completed extensive shops at a more central location on the line of that road, ordered the Dunkirk shops to be permanently closed, and the machinery removed to other locations. Mr. Horatio G. Brooks, at that time superintendent of motive power and machinery of the Erie Railway, whose home was at Dunkirk, and whose interests were identified with the welfare of that place, made a proposition to Mr. Gould for a lease of the shops and machinery for the purpose of establishing the business of locomotive-building. The lease was consummated in November, 1869, and before the close of the year the first two locomotives of the new Brooks Locomotive Works Company were turned out. The growth of the works since that time has been constant, until their capacity at the present time is 400 locomotives per year. During the year 1883 the property, comprising twenty acres of land, the permanent plant, additions and machinery were purchased from the New York, Lake Erie and Western Railroad Company by the Brooks Locomotive Works. These works employ about 1500 men. At the present time Mr. M. L. Hinman is president and treasurer, and Mr. R. J. Gross vice-president.

The Richmond Locomotive and Machine Company of Richmond, Va., is the only locomotive-manufacturing plant in the South. The works were established in 1865 for the manufacture of plantation and saw-mill machinery, and were gradually adapted for the construction of tram and street-car motors. In 1880, the shop having been destroyed by fire, it was removed beyond the city limits and reconstructed upon an enlarged scale. In 1889 it secured the contract from the United States government for building the machinery of the armored battle-ship *Texas*, which gave it wide prominence. This contract was successfully executed, but the works have since been devoted exclusively to the construction of locomotives. They give employment to 1200 men, and have an annual capacity of 200 locomotives.

22*

The Dickson Manufacturing Company of Scranton, Pa., are important manufacturers of locomotives and of mining machinery, for which their location in the anthracite coal regions of Pennsylvania is most suitable. These works were established in 1862. They have a capacity of 100 locomotives annually, and employ from 400 to 450 men.

The Manchester Locomotive Works, of Manchester, N. H., established in the early fifties, are under the management of Aretas Blood. They employ about 700 men, and are capable of producing about 100 locomotives annually.

From the foregoing it is apparent that, exclusive of such locomotives as are built in railroad shops or shops not regularly engaged in the business of locomotive building, the locomotive-manufacturing establishments of the country have an aggregate capacity of about 3000 locomotives a year. At the present time this capacity is largely in excess of the requirements of the country. The actual reported production of the past six years, with the number exported (not including Canada and Mexico), is as follows:

LOCOMOTIVES PRODUCED AND NUMBER EXPORTED.

Year.	Total Production Reported.	Number Exported (Omitting Mexico and Canada).	Remainder not Exported.	Number of Works Reporting.
1889	1860	187	1673	16
1890........	2213	137	2076	14
1891	2300	357	1943	15
1892........	1764	141	1623	12
1893	2011	205	1806	13
1894	695	189	506	13
Average...	1807	203	1694	

The total number of locomotives in use upon the railways of the United States, Canada, and Mexico for the same years, as reported to "Poor's Manual," is as follows: 1889, 31,062; 1890, 32,241; 1891, 33,563; 1892, 35,281; 1893, 36,012; 1894, 35,813.

As the average life of a locomotive may be taken at twenty years, it is apparent that an annual production of about 1800 locomotives will supply the natural wear, whilst there is in the country a capacity for constructing in contract and railroad shops about twice that number. The difference between the number requiring replacement on account of natural wear and this total capacity must be absorbed by locomotives for new lines, for permanently increased traffic, and for export. The locomotive-building establishments above mentioned employ in the ag-

gregate 15,000 men, who receive in wages about $10,000,000 annually. The total value of the product of these works, when operating to their full capacity, is about $30,000,000.

Although the earliest locomotives used in the United States were imported from the mother country, it was not long before the achievements of American mechanics attracted attention abroad. In 1845 the Baldwin Works exported locomotives to the Royal Würtemberg Railroad. In 1848 Rogers shipped locomotives to Cuba; and while the exportation of locomotives during recent years has been largely to those countries without the resources requisite for locomotive-building, in the earlier years it was not uncommon for American manufacturers to ship their products to Austria, to England, and elsewhere in Continental Europe. Statistics fail to show the number of locomotives exported during the earlier years, and even recent statistics are inaccurate in not covering shipments of locomotives to Canada and Mexico. During the twenty-five years comprised within the period from 1871 to 1894, there were exported 2879 locomotives to countries exclusive of those reached by rail connections from the United States. These locomotives were distributed throughout South America, Cuba, Australia, Japan, Norway, Sweden, Russia, South Africa, and the Islands of the Pacific. The shriek of the American locomotive is heard in the Holy City. Although the line from Jaffa to Jerusalem was constructed by French capital, the locomotives were supplied from the United States.

The market price of a locomotive in 1832 appears to have been $4000, this sum having been agreed upon between Matthias W. Baldwin and the Philadelphia, Germantown and Norristown Railroad for the locomotive "Old Ironsides." The highest prices known in locomotive-building, as in other industries, were those obtained during the War of the Rebellion, when heavy freight or passenger locomotives commanded from $30,000 to $35,000. Prices declined after the close of the war to about $7000 for a thirty-five-ton passenger locomotive in 1878–79. During the so-called boom of 1880–81, prices again rose to about $15,000 each for similar passenger locomotives; but since that time there has been a constant reduction in the price per pound, the weights of locomotives gradually increasing with the demands of increasing traffic, while prices have remained nearly stationary at about $8000 to $9000 each for average passenger locomotives, and from $9000 to $10,000 each for average freight locomotives.

The importance of fuel economy was appreciated in Europe earlier than in the United States. Progress had been made in the development of the compound locomotive by Lindner, Von Borries, La Page, Worsdell, Webb, and others. W. S. Hudson, superintendent of the Rogers Locomotive Works, designed a two-cylinder, or cross-compound, locomotive, as early as 1873, but it was never built. In 1882 Henry D. Dunbar designed and patented a four-cylinder tandem compound locomotive, which was tested on the Boston and Albany Railroad. In 1889 the Pennsylvania Railroad imported from England a compound locomotive of Webb's pattern for experimental service. The same year Samuel M. Vauclain, superintendent of the Baldwin Locomotive Works, designed a four-cylinder compound locomotive, in which a high-pressure and a low-pressure cylinder are placed one above the other on each side of the locomotive, both formed within a single casting, together with the steam-chest, and occupying the same place as the ordinary single-expansion cylinders. The two piston-rods connect to a common cross-head. From the cross-head pin back, the locomotive does not differ in any essential respect from the ordinary engine. The first locomotive of this pattern was built the same year for the Baltimore and Ohio Railroad. Tests indicated highly economical results. About the same time A. J. Pitkin, superintendent of the Schenectady Locomotive Works, brought out a two-cylinder, or cross-compound locomotive, having a form of intercepting-valve differing from those previously used abroad. The general interest in compound locomotives, together with the powerful influence of two of the most prominent works in the country, led to the rapid introduction of compound locomotives, and caused other locomotive-builders to bring out similar designs. There have since been built in the United States about 800 compound locomotives, of which nearly 600 are of the Vauclain pattern, four are of the four-cylinder "tandem" type, and most of the remainder are of the two-cylinder or cross-compound type. The compound locomotive is unquestionably a step in advance, realizing as it does an economy of from fifteen to forty per cent., according to the service in which it is employed.

The most conspicuous improvement in transportation, which resulted from the introduction of steam-power, was the great increase in the capacity for high speed. Peter Cooper's first locomotive is said to have attained a speed of eighteen miles per hour. Baldwin's "Old Ironsides" is recorded as having attained a speed of sixty miles per hour for a short distance. Speeds of sixty miles per hour have

therefore been known from the inception of American railways. The real progress of locomotive development has not been so marked in increasing the capacity for speed as in increasing the weight of trains which can be hauled with certainty at rates of speed which have previously been regarded as phenomenal. Up to the year 1889, when the compound system was introduced, there did not exist a demand for sustained speeds exceeding fifty miles per hour. In November, 1892, one of Vauclain's compounds, No. 385, running on the Philadelphia and Reading and the Jersey Central railroads, between Philadelphia and Jersey City, with a train of four heavy cars, attained a speed of ninety-seven miles per hour by covering one mile in thirty-seven seconds. On May 10, 1893, locomotive No. 999, of the New York Central Railroad, is said to have covered a mile in thirty-two seconds, equivalent to 112½ miles an hour, hauling the Empire State express, consisting of four heavy cars. On July 19, 1893, engine No. 682, of the Philadelphia and Reading Railroad, hauled a train of nine loaded passenger cars from Winslow Junction to Pleasantville, twenty-six miles, in twenty-two minutes, or at the rate of 70.9 miles per hour, and on August 27th, the same locomotive hauled seventeen loaded passenger cars over the same distance in twenty-seven minutes, or at the rate of fifty-seven miles per hour. These performances are remarkable for the weight of the trains hauled. The locomotive is a Vauclain compound. On September 11, 1895, a locomotive of the New York Central and Hudson River Railroad hauled the Empire State express, consisting of four cars, from New York to East Buffalo, 436½ miles, in 407⅔ minutes, being an average speed of 64.26 miles per hour. It is believed that the steam locomotives of to-day possess capacity for running at as high a speed as is required by public demand, or as is consistent with the commercial conditions governing the business of transportation.

During the past few years the general substitution of electric power for horse-power and for other means of propulsion on tramway lines has caused electricity to be regarded as perhaps a rival of steam, or at least as a competitor which may prove to be a serious rival in the future. The progress of electrical science is so rapid that what is written to-day is obsolete to-morrow. What we regard as impossibilities now may shortly become established facts. In 1840 Davis & Cook constructed a walking-beam engine with a zinc and copper battery, using a solution of blue vitriol. In 1842 Davidson, of Scotland, constructed a five-ton electric locomotive, which was actuated by seventy-eight pairs of thirteen-inch-square zinc and iron plates in sulphuric-acid solution, and propelled itself at the rate of four miles an hour. In 1844 Channing conceived the idea of substituting electro-magnets for permanent steel magnets, and of exciting the field magnets by an electro-magnetic machine. This idea was subsequently developed by Henry Wilde, Manchester, England, between 1863 and 1866. In 1847 Farmer constructed an electro-magnetic locomotive having forty-eight pint cup cells of Grove nitric-acid batteries. This drew a car containing two passengers on a track of eighteen inches gauge. In 1850 Page, of Washington, constructed an electro-magnetic locomotive of sixteen horse-power, actuated by 100 cells of Grove nitric-acid batteries, having platinum plates eleven inches square. This machine propelled a car carrying a dozen or more persons on the Baltimore and Washington Railroad, at a speed of nineteen miles an hour. In 1851 Thomas Hall, of Boston, constructed and exhibited a small electric locomotive which took its current from a stationary battery by means of the rails and wheels. It was arranged automatically to change the current and return at the end of the track. In 1860 he made a more elaborate model called the "Volta," which was exhibited at the American Mechanics' Fair. In 1859 Farmer invented what he designated the self-exciting dynamo, which was constructed in 1860. Improvements on this were made by Wheatstone, Leaman, and Ladd in 1867, and by Gramme in 1871. It made possible the substitution of the dynamo for the galvanic battery, and permitted the generation of electricity at low cost.

The first experiments in the use of electrical locomotives on steam roads appear to have been made by Leo Daft on the New York Elevated Railroad with a motor of 125 horse-power. In 1886 Frank J. Sprague conducted experiments on the same road with trains of individual motor-cars. In 1891–92 the Thomson-Houston Electric Company built a locomotive of about 125 horse-power for freight service at Whitinsville, Mass. This locomotive handles an aggregate load of 200 to 300 tons at a speed of five miles an hour. In 1892 the North American Company ordered from the Baldwin Locomotive Works a powerful electric locomotive to be constructed from the plans of Sprague, Duncan & Hutchinson, Limited. This locomotive was completed in 1894 and weighed sixty-seven tons. It had four pairs of wheels connected by coupling-rods, and the field magnets were hung from the driving-boxes, whilst the armature was

hung on the driving-axle. In 1892 the General Electric Company undertook the construction of an electric locomotive for the tunnel of the Baltimore and Ohio Railroad in Baltimore. This locomotive was completed in 1895, and was designed to weigh ninety tons and develop 1500 horse power. In 1892–93 the General Electric Company equipped in the grounds of the World's Columbian Exposition at Chicago, and operated during the period of the Exposition in 1893, an elevated railroad known as the Intramural Railway. Its mechanical success was such that in 1894 the Metropolitan West Side Elevated Railroad, which had been designed as a steam line, countermanded an order for twenty-five steam locomotives and substituted electric power. In 1895 the Lake Street Elevated Railroad of Chicago discontinued the use of steam locomotives and substituted electric power. The same year the New York, New Haven and Hartford Railroad equipped its Nantasket Beach branch electrically for experimental purposes, and the Pennsylvania Railroad equipped a branch road at Mt. Holly for the same purpose. In 1895 the Baldwin Locomotive Works consummated a working agreement with the Westinghouse Electric and Manufacturing Company, for the production of electric equipment for railway service. There is a large field for electricity in railway work, and it is probable that after it has been applied to switching and suburban service in the great cities, public opinion will compel the abandonment of steam locomotives in these precincts.

Although the steam locomotive is more prominently brought to the attention of the public, and is therefore more popular and better known, yet it has no greater effect on daily life than other steam engines. Mention has been made of steam-power applied to transportation in navigation on the ocean and on inland water-ways, but besides this use for steam it supplies a thousand wants of daily life, such as the furnishing of the water-supply of great cities, the driving of the machinery of busy hives of industry, the lighting of streets and houses, the running of elevators in high modern buildings, the extinguishing of fires, the operating of the electric tram-car, and in many other ways meeting the wants of modern civilization. For many years the development of the stationary engine and the marine engine were identical. The first experimental steam engine built in the United States is said to have been constructed in 1773 by Christopher Colles, a lecturer before the American Philosophical Society at Philadelphia. In 1787 John Fitch launched on the Delaware River at Philadelphia a steamboat propelled by paddles, which attained a speed of thirteen miles per hour, and in 1796 he experimented in New York with one operated by a screw. His efforts were closely followed by those of Robert Livingston. About the same time other mechanics were devoting attention to the problem of steam navigation, among them Samuel Morey, Nathan Read, Nicholas Roosevelt, Oliver Evans, Robert Fulton, John Stevens, and others. Transatlantic steam navigation began in the year 1819, when the American steamer *Savannah* made the trip from Savannah to St. Petersburg. The development of the marine engine through its various forms of single expansion, compound, and triple expansion cylinders has resulted in the powerful mechanisms which drive the *Campania*, the *Lucania*, the *Paris*, the *St. Louis*, and the *St. Paul*, at the rate of 500 miles per day. This development has resulted from the labors of many, among whom may be mentioned John and Robert Stevens, Robert Thurston, James P. Allair, the Copelands, and John Ericsson.

Since 1850 the improvements have been rather in details of construction than in any marked change in type. The engineer has striven and is still striving for the highest efficiency with the greatest degree of economy. The introduction of what is known as the Corliss valve gear marks probably one of the greatest eras in engine building. This is a device by which the steam is admitted into the cylinder for any desired portion of the stroke, and the point of cut-off automatically maintained by the governor without affecting in the least the free opening of the exhaust. Many devices had been introduced before this time for the purpose of using the steam expansively, among which may be mentioned that of Frederick E. Sickles, in 1841, whose drop cut-off with detachable valve gear was used in this country until 1849, when George H. Corliss brought out the improved expansion gear which bears his name, and which is used to-day by builders all over the country. The adoption of the surface condenser may also be noted as an improvement of great practical utility in the economy of that class of engines to which it is adapted.

As the country developed, there was an ever-increasing call for smaller engines with higher speed and higher steam pressure. Excessively high pressures had already been experimented with as early as 1823 by Jacob Perkins, who in 1827 constructed a single-acting engine in which steam of 800 pounds pressure was used, and in the same year he made a compound on the Wolfe plan, in which he adopted a pressure of 1400 pounds, expanded eight times. He

even went so far as to propose to adopt a pressure of 2000 pounds, using engines with small cylinder dimension and cutting off the admission at one sixteenth of the stroke. For obvious reasons these excessive pressures were not adopted in general practice, but the experiments had the effect in later years of calling the attention of builders to the greater economy of high pressure steam, and engines and boilers were adapted to its use in a moderate degree. This caused inventors to consider different plans by which high pressures could be utilized and high speed engines constructed. A number of designs were executed, among which may be noted the Westinghouse, which is a double-cylinder, single-acting engine. The low cost and simplicity, combined with a high degree of efficiency, have brought this engine into extensive use.

The competition among engine builders has caused marked changes to be made in simplifying and reducing the cost of manufacture. Probably no change which has been made equals that, adopted by nearly all builders of what may be called the merchantable engine, of reducing the number of main parts to a single column or bedplate, in which the revolving and reciprocating parts are supported and the cylinder secured directly to this column or bed. Engines of this class, both vertical and horizontal, are manufactured by builders all over the country, and perhaps no better estimate can be derived of the advance in this particular than to consider that in 1795 there were exceedingly few in this country who were interested in the introduction of the steam-engine, whereas in 1895 scarcely a town of any importance exists which does not boast of one or more shops where steam-engines are built. The marked advance in the efficiency of the steam-engine may be seen when we consider that previous to 1850 it took from five to eight pounds of coal and something like eighty pounds of water per horse-power per hour to operate what was then considered the best class of engine, whereas to-day the same work is done with an expenditure of one and eight tenths pounds of coal and fifteen pounds of water per horse-power per hour. The manufacture of stationary engines is so widely distributed and so extensively followed that neither in the United States Census nor in other compilations of statistics is it possible to determine the number of men employed, the number of employers interested, the amount of capital involved, or the value of the productions of this branch of engine building.

The steam fire-engine is an important factor in securing the safety of human life and property, and the improvement in such engines within fifty years has been great. Captain John Ericsson built a portable steam fire-engine, which was tested in New York City in 1842, but was not put into regular service. The time required for raising steam was then eighteen minutes. Steam fire-engines were put into permanent service in Cincinnati about 1853, and at that time steam could be raised in less than four minutes from the time the torch was applied. Economy is not a matter of prime importance in steam fire-engines, the first requisites being power and portability. Modern machines of beautiful design and superb workmanship can be drawn by two horses, and can be made ready for delivering enormous quantities of water within three minutes after the sound of the alarm. This comparatively small apparatus can throw a stream of water over all except the highest buildings in the large cities, and can run for hours without damage. The boiler of the steam fire-engine is one of the most powerful for its weight used in any practical work. The fire-engines manufactured in the United States are admittedly superior to those manufactured elsewhere. This superiority has doubtless resulted from the need ot the most efficient apparatus to protect cities largely built of wood, and which are much more subject to conflagration than those of older countries, where brick and stone are the principal materials used in construction.

While the progress of steam-engineering during one hundred years has largely revolutionized the methods of living, this development has not reached its termination. On the contrary, the engines and boilers which have recently been used in torpedo boats, the experiments of Maxim in England, and of Langley in the United States, introducing steam-engines and boilers of power heretofore inconceivable for their lightness, and the light engines and boilers which are used in road carriages, indicate that we may expect in the near future an enormous saving in the amount of coal used in producing power, and in the convenient subdivision of power for a great variety of uses. It is reasonable, therefore, to expect that this advance will continue at an accelerated pace, and it may be predicted that the further development of steam engineering will result in the increased conservation of the world's resources and in an added contribution to the comfort and happiness of mankind.

A. B. Johnson

CHAPTER XLIX

MACHINERY MANUFACTURING INTERESTS

WHEN the harvest of a century is gathered we are able to measure its quantities and to determine its values; but the improvement in the arts of a century can be estimated only by comparing the conditions existing at its beginning with those at its close.

Looking backward, then, to 1795, we discover a sparsely settled country, with means of transportation limited to the slow ox or to the more speedy horse; the forest is cleared by a clumsy axe, adapted more for dressing the timber after it is felled than for felling it; the ground is tilled by the spade and the plow of wood, saving only the coulter and sometimes the mould-board, which turns the soil but little below the surface; and the harvest is gathered by the scythe and the sickle, wielded by arms and hands strengthened and hardened by toil. A few sawmills have existence, but most of the timber for construction is hewed. The grist-mill is the most complex piece of machinery; its shafts and gear-wheels are of wood, and its owner, the jolly miller, depends upon his customers not only for his tithe of the grain, but also for the assistance necessary to grind it. The condensing steam-engine of Watt, patented in England in 1769, was only practically at work there for the first time in 1776. The non-condensing engine of Oliver Evans had demonstrated here in 1780 that it would operate, but in this country both the condensing and the non-condensing engine were absolutely unknown in practice. The spinning-frame of Arkwright, introduced into England in 1771, was as yet an experiment here. The spinning-wheel propelled by the foot, and the loom by the foot and the hand, were the sole domestic agencies for clothing the people and their beds, upholstering their furniture, and providing their table-napery. Iron had been made in the forge for more than a century, and castings of iron of uncertain quality were supplied from the small cold-blast furnaces, whose output was from one and one half to two tons daily, a few of the largest making from twenty-five to thirty tons per week. With few exceptions every kind of production was by hand, or if machinery aided, it was directed at every stage by human intelligence. When in 1771 Arkwright established his spinning-frame in England, and a few years later Oliver Evans organized a flour-mill in this country to execute the several operations of the mill previously conducted by the miller, machinery was enabled for the first time to perform successive but dissimilar operations without human direction.

The jealous policy of Great Britain, which aimed to concentrate within her borders all the improvements in the arts, prompted legislation from 1750 to the close of the century, first to prevent the manufacture of iron in this country beyond the stage of pig and bar, then to prevent the exportation from Great Britain of any "tool or utensil used in working up or finishing cotton or linen, woolen or silk manufactures, and of any other tool or utensil which now is, or at any time or times hereafter may be, used in working, finishing, or completing of the iron or steel manufactures of this kingdom," under penalty of forfeiture of such tools or utensils, a fine of £200, and imprisonment for twelve months. That the unfortunates outside of the kingdom should never be enlightened, they were forbidden, under penalty of £500 and imprisonment in the common jail for twelve months, "from seducing artificers, and others employed in the manufactories, to depart out of this kingdom; and if any artificer has promised or contracted to go into foreign parts to practise or teach his trade, such artificer may be obliged to give security, at the discretion of the court, that he shall not go beyond the seas, and may be committed to prison until he give such security."

At the close of the last century and during the early part of this, these acts were rigidly enforced, and they were not rescinded until 1845. In con-

sequence of this legislation machinery could not be obtained from England, and the only alternative was to rely upon our own mechanical ability and construct what was needed at home. Our workmen were skilled in the use of the axe, the adze, and all carpenters' tools; they had successfully constructed our sawmills and grist-mills, in which the gearing and shafting were of wood, the latter revolving upon small iron journals ingeniously secured in the ends of the wooden shafts. Our blacksmiths fashioned our iron with facility in the forge, but the new machinery then coming into extensive use in England demanded that this iron should receive a higher finish and be given a more exact form than could be afforded by the forge, and out of this necessity the machinist was born.

From the "History of American Textile Machinery," by John L. Hayes, LL.D., we learn that Samuel Slater, a young Englishman, aided by the capital of some enterprising men in Providence, R. I., constructed at Pawtucket, in that State, in 1790, the first of the textile mills in this country to use the Arkwright system. All of its machinery was built by him on the premises, and we may conceive the difficulties under which he labored when we consider that he brought with him from England no plans or models of the machinery, and in that age of the world not one of the machines now so common for shaping cold iron had existence. What expedients he must have resorted to, and what a school it was for his workmen! At this period woolen cloth fabricated in the household was the only domestic source of the supply of that article; but in 1793 John Schofield and his family, with his brother Arthur, emigrated from England to this country, and, being well skilled in the most approved method of manufacturing woolen goods in England, constructed, with the aid of some persons of wealth in Newburyport, Mass., the first carding-machine that was worked in the United States. This apparatus was first turned by hand; but when the remaining machinery was completed the factory was put into operation by water-power, the business thenceforth being conducted prosperously. Like the cotton-mill of Slater, the machinery of this first woolen-mill was built by Schofield on the premises. Rude indeed must such machinery have been; but it served its purpose, not alone to prepare the fiber and to spin the yarn for which it was designed, but also to educate every man, woman, and child who aided to construct or to operate it.

Out of such experience came, first, that adjunct of the lathe, the slide-rest, the progenitor, in fact, of nearly all the appliances for automatically shaping cold iron. At this time the lathe had but lately advanced beyond the first stage of its existence, that of two dead-centers, which supported the work as it was rotated backward and forward by a band around it, one end attached to a spring-pole above it, the other end to the foot of the operator, while the turning-tool was held in his hand. Think of the skill and the patience required to produce good work with such an implement! And yet with no better appliance all of the domestic turned work of our colonial period was executed.

The lathe had now, however, advanced beyond this first stage, and was provided with a revoluble spindle and center, by which the work was axially supported and rotated; but the tools for turning either wood or iron were still held and manipulated by hand. The new industries demanded large numbers of cylindrical iron pieces exactly parallel and of like diameter, for the production of which manual skill was inadequate. This want was supplied by the slide-rest, which theretofore had been found only in the workshop of the optician and the mathematical-instrument maker, but was now to become a common adjunct of the lathe. From this time the capacity of the lathe to produce cylindrical work of the required exactitude was unlimited, but the workman had to manipulate the slide-rest to enable the cutting-tool which it carried to perform its work. The preparation and the adjustment of the cutting-tool, as well as its rate of traverse, required skill; but to perform the work after that demanded only constant attention, and the number of workmen who could patiently give that was limited. As a consequence the slide-lathe was introduced, whereby the advance of the cutting-tool, and the rotation of the work, were automatically performed. The facilities for producing the long, flat, and straight surfaces best adapted for such a machine were then limited to the hammer and the cold-chisel, the file and the straight-edge, the latter then produced by grinding three surfaces alternately upon one another until they touched uniformly, in any order of pairs. The slide-lathe, therefore, had a curious development. The hand-lathe, with its wooden bed and short slide-rest, could produce cylinders economically, and these were utilized for slide-lathe beds; but lacking stability, as well as security for the slide-rest, the cast-iron bed dressed by the cold-chisel and the file was finally adopted. The form of the guiding surfaces of the slide-rest was, however, modified in the lathe to save hand labor, and this distinctive form has maintained an existence to the present day.

The next development of the slide-rest was the planing-machine, whereby the rough and irregular surface of the castings and forgings, traveling slowly under a cutting-tool movable at right angles to the travel of the work, was smoothed and reduced to a true plane. The advent of this machine was an era in the life of the machinist, as great, perhaps, as that of the slide-rest. I am unable to determine when the first one was started, but to give some idea of its development I may say that in 1838 it was generally understood that there were but four of these machines in the United States. With this machine it was at once possible to construct lathes of increased capacity, power, and exactitude. The drill, which before that had been limited to a revolving vertical spindle, was endowed with an iron frame, and a table at right angles to it, upon which the work might be rigidly supported and adjusted with ease and certainty. The boring-mill or vertical lathe was then economically possible, and took its place in the machine-shop to execute a large class of turned work that did not require to be supported upon centers, or as preparatory thereto. Much of this work consisted of wheels that had to be keyed upon their shafts. The seats for these keys were chipped and filed, and the first development of the planing-machine was the key-seating machine, in which the tool moved while the work was fed against it. The capacity of such a machine for other work was soon developed, and when provided with compound slide-rests and a revoluble table mounted thereon, it took its place as a standard tool in the machine-shop, under the name of the slotting-machine. This planer, with its vertically movable tool, was the progenitor of a machine with similar attachments, but with its tool moving horizontally, upon which work could be conveniently shaped in a great variety of forms; and the shaping-machine, as it was called, soon became one of the standard tools of the machine-shop.

With the advent of these tools the art of driving the cold-chisel and of guiding the file, once the criterion of a good workman, was rarely exercised. In the mean time, however, the vertical spindle-drill, with its compound tables, movable vertically and adjustable horizontally in two directions at right angles with each other, had been supplemented by the horizontal drill, with similar tables, but with its drill-spindle parallel to the tables; and the further requirements in this direction had been supplied by the radial drill, in which the vertical drill-spindle is movable about a vertical axis, toward and from which it is adjustable radially.

The development of the machine-shop was not, however, exactly in the order above indicated; it had other requirements which these tools supplied inadequately, if at all, among which were the screw-bolts and nuts for securing the parts of the machines together, a want which had been imperfectly supplied before even the original lathe had an existence. The iron screw-bolt was then formed by compressing a split die upon it, provided with spiral threads, and rotating the bolt or the die backward and forward until the thread was partly cut and partly raised to its completed form, while a taper-tap was screwed into the nut from one side and then from the other, until by trial the nut was found to enter upon the bolt. The apex of the thread was always larger than the diameter of the bolt, and bolts and nuts were only interchangeable by accident. The slide-lathe made it possible to cut out the thread without raising it, but for the great mass of bolts this was far too expensive, so that the split die continued to produce its imperfect product in this country until the solid die patented by Philetus W. Gates, May 8, 1847, with sectional threads, was introduced. After this die had cut the thread at one pass, its direction of rotation was reversed to unscrew it from the bolt, which not only left a mark upon the thread, but was liable to injure the die, and no compensation for wear was possible. It was not until 1857 that a bolt machine was devised by William Sellers, and constructed by his firm in which dies to cut the thread at one pass, and adjustable to size, could be opened and closed while running continuously in one direction, and thereafter ordinary screw-bolts could be made interchangeable. In 1860 this tool was introduced into England, and subsequently upon the continent of Europe.

Another of the early machine-shop tools was the gear-cutter, simply a revolving milling-cutter against which the wheel was forced, mounted upon a spindle above the dividing-plate on the same spindle. The only power used was that required to rotate the cutter; the movement against the cutter and its reverse, and the division or adjustment for the next tooth, being all performed by the workman. The cost of such work was so great that the teeth of nearly all wheels, even for fine machines, were cast, until a machine was devised by William Sellers, and constructed by his firm in 1867, and exhibited at the exposition in Paris in the same year, in which the work of the operative was limited to adjusting the wheel to be cut to the cutter. After that the machine proceeded with the work of cutting each tooth, retracting the cutter, turning the wheel for the next

William Sellers.

tooth, and so on, until the wheel was completed in less time than it could be done when these movements were effected by hand; so that now one man can easily attend several machines, and cast teeth are no longer admissible in good machines.

One other typical machine-tool which has received its greatest development in this country must be referred to—the milling-machine, by which the various shapes for use or for ornament in our firearms are fashioned. Its use is so varied that it has become a necessary adjunct to every machine-shop, and I close with this the list of machine-tools necessary to make other machines. It must not be supposed, however, that the above comprise all or nearly all of the machine-tools now in common use; they are but types, upon which an infinite variety of changes have been wrought to adapt them to special requirements. Their development marked the first stage of the machinist's art, when machine-tools were only required to perform the simple operations of turning and planing, drilling and milling, to make other machines.

Along with the development of these tools for general purposes came a development of the system of interchangeability as an economical principle in manufacturing machinery, requiring in some instances special machines, but more commonly special tools or appliances for use in connection with the ordinary machine-tools. While it cannot be claimed that this country was the first to attempt manufacturing machinery upon this principle, it must be admitted that the system was in successful use here very many years in advance of any other nation, and that, in fact, the demonstration here that the system was economical, as well as advantageous in other respects, induced the nations of Europe to adopt it and procure the necessary apparatus here to establish it at home.

For the economical manufacture of machinery or of apparatus in which large numbers of the parts shall be interchangeable there are certain preliminary conditions which must be observed: first, reference standards must be provided, with which to compare the several parts and determine the tolerance—that is to say, the amount of variation permissible between the standard and the product; second, every part of the finished piece must be completed without the intervention of hand labor; and third, for every piece a base must be established, to which each and every succeeding operation must refer; consequently every piece must form a separate study to determine the best appliances for each operation, so that the efficiency of the operation shall not be dependent upon the skill of the operator.

The first application of these principles was made upon firearms in our government arsenals, under the direction of Mr. Eli Whitney, the inventor of the cotton-gin. The growth of the system must have been slow, and confined for a long period to a few of the principal parts; but from the first it had proved economical, for in 1822, Mr. Calhoun, then Secretary of War, admitted to Mr. Whitney that the government was saving $25,000 per year at the two public armories alone by the use of his improvements. The drop forging-press, with its dies conforming to the shape desired, served to produce expeditiously in red-hot metal all of the smaller parts of the gun, closely approximating the finished size and shape. The milling-machine, when its capacity was developed, finished these forged parts, however varied the shape, with an accuracy well within the limit of tolerance; and the drill, when the order of procedure had been determined and the guiding templets were provided, fashioned the bearings for the working parts and the holes for securing the parts in position. The wooden gun-stock, of irregular form, was rapidly and automatically shaped exteriorly as it and its model revolved in a lathe designed by Thomas Blanchard, and patented by him January 20, 1820. Other special tools routed the groove for the gun-barrel and the cavity for the lock, with the other details required to receive the guards and fastenings of the gun, with such accuracy that the several parts could be assembled as they came from the machines. The accuracy then attainable, however, was far short of that now demanded; the gun then produced did not require it. The machine-tools were limited in variety and comparatively rude of structure, so that the quality of their work could not be depended upon. The vernier caliper was the most delicate instrument of measurement, and a thousandth of an inch was its extreme limit of accuracy, while the form of the screw-thread did not admit of very accurate determination.

As the quality of our machine-tools improved, the skill of our workmen advanced and their appreciation of accuracy was enlarged. Appliances necessary to detect with certainty an error of the twenty thousandth of an inch were supplied by the Pratt & Whitney Company, after designs by Professor W. A. Rogers and Mr. George M. Bond; and the form of screw-threads advocated by Mr. William Sellers in a paper read before the Franklin Institute, April 21, 1864, has since become the standard for the

United States; so that now a degree of accuracy is easily attainable which, at the introduction of the system, was impossible. The failure of the earlier attempt to establish an interchangeable system of manufacture in France was perhaps due to rude apparatus; but from the description that has come down to us it would seem that the cardinal conditions before referred to had not been observed, with the result that a commission appointed by the French government in 1791 decided that it was inexpedient to establish a central manufactory of locks, mainly for the reason that it had not been found economical, and in 1807 the last factory engaged in the manufacture was suppressed.

From the first our method of working the interchangeable system had proved economical, and, with the growth of excellence in every detail of machinery, the system had been so extended and improved that the knowledge of its advantages reached to foreign countries, and various commissions were appointed to investigate it. In 1870 the German government contracted with the Pratt & Whitney Company for gun machinery to the value of $350,000, and within the next three years for $1,250,000 more; and until 1875 the company was kept busy on European orders. By a supplemental contract with the German government the Pratt & Whitney Company agreed to superintend the erection of the machinery they had furnished, and to instruct native workmen how to operate it. The results were so satisfactory that, departing from precedent, the authorities forwarded a letter, from which the following is an extract:

"The Pratt & Whitney Company has furnished the royal armories of Spandau, Erfurt, and Danzig with plants of machinery which execute the work with such nicety and precision as to save one half the wages, and to render the government in no small degree independent of the power and skill of the workmen." About the same time other manufacturers of gun-making tools—notably Brown & Sharpe, of Providence, R. I.—received large orders for such machinery from other foreign countries, and our system for the manufacture of this class of interchangeable parts was thus established in England and on the continent of Europe.

The record, therefore, discloses the fact that for more than half a century this country has been in possession of a system of manufacture peculiar to itself, developed first in the manufacture of the larger class of firearms, then extended to pistols, and subsequently to a great variety of products, such as the sewing-machine, the type-writer, the bicycle, and the watch, in all of which we stand to-day unrivaled.

Within the period I have been reviewing every art has advanced enormously, and many have been developed that had no previous existence. The farmer no longer scratches the surface of his fields. His plow of steel suffices to turn the sod to a depth that compels a more bounteous harvest; his seeds are planted and his crops are tilled by machines which he rides and guides; and his harvest is cut and cured by still other machines, that carry him to their work, obedient to his will.

Textile fabrics, at first hand-made, by successive steps have become the product of machinery to which the raw material is supplied, and from which the finished material only is removed by hand. The twine for the fisherman was once spun and the meshes of his net were knit by hand. But he need no longer knit, because he can buy his net for less than he must pay for the twine of which to make it. The yarn for knitting, formerly hand-made, is no longer in the market, and its knitted product, once a fireside occupation, is now supplied at a cost that even those so-called idle hours could not compete with. Boots and shoes then required a skilful workman to produce. Each was the work of one man. But the shoemaker no longer exists. More than half a hundred workers each contributes his mite to the shoe which machinery produces, while garments then cut out and laboriously stitched by hand are now fashioned in piles and stitched and buttonholed by machinery. While machinery has thus been adapted to feed and to clothe us, it has been taught to produce almost every article required in the household or the workshop. Indeed, the very houses that shelter us no longer represent the skill of the joiner, for the mill has usurped his place, and the carpenter only assembles its work.

The same changes have occurred in the fabrication of metals. The blast-furnace, whose maximum product early in the century was 25 to 30 tons per week, now produces 500 tons per day. The bloom of iron, then the unit from which the largest masses were built up, small as we now regard them, has given place to the ingot of steel, weighing many tons, which requires less labor to produce than the bloom of as many pounds. The forge and the rolling-mill which fashion the ingot in great masses are new creations, and the machines which shape it in detail with such marvelous rapidity, and at one heat, are developments so great that the original parent is barely recognizable. In transportation the team of horses has long since been displaced by the loco-

motive, and present indications point to another and more efficient substitute.

The immense number of similar parts which the automatic machinery of these and other industries demanded afforded opportunity for the introduction of machine-tools to manufacture machinery, as distinguished from those designed simply for making it. The difference may be illustrated in the two processes of making a turned bolt with a square or hexagonal head, the one after the introduction of the slide-lathe, and the other at the present time. Then, a bar of iron of suitable size was heated and forged by the smith to a size and shape approximating that of the finished article; this was centered; a carrier was secured upon one end whereby it could be rotated; the end opposite the carrier was squared in the slide-lathe by a side-tool, the carrier was transferred to the other end of the bolt, and the opposite end was squared, the side-tool was changed for another tool, adapted to turning the body of the bolt, and this again for another, adapted to cutting the thread. At each change of carrier and of tool the lathe was stopped that the workman might release the one tool and secure the other. Now, the iron bar, square or hexagonal, and of the size and shape of the head of the bolt, is delivered from the rolling-mill to the attendant of the machine, who thrusts it into the machine against a stop; the machine grips it, squares off the projecting end, turns up the body of the bolt, cuts the thread, bevels the end, and finally cuts off the bar beyond the last turning, to make a head, and the bolt drops, a finished product. The machine releases the bar, moves it forward the distance required for another similar bolt, and repeats its operations, until the bar is converted into bolts; and it could, if desirable, inform its attendant that it was out of work, or notify him of the fact by stopping its movement. The attendant is no longer of necessity a machinist, for his only occupation is to provide his machine with bars, to remove its product, and to keep it clean, duties which attendance upon a number of such machines does not make onerous. The turned bolt so manufactured is as good as, but no better than, that which was first forged and then finished upon the simple slide-lathe; but the product of the workman is vastly greater, and the skill required for it is far less. For such apparatus quantity of like product is the first requisite. Given this, and the skill of the engineer and the machinist is demanded to produce by successive automatic operations the desired result. These operations without the intervention of human intelligence may at first be few in number, but they will be extended from time to time as experience warrants or as future discoveries may render possible.

The field, then, for machinery and for manufacturing interests is forever widening. Every secret of nature that is unfolded, every discovery in the arts, every combination that produces new results, only opens other avenues of progress, which must become more rapid and more diverse with the growth of the centuries.

At the close of this century, however, it should be noted that within the period I have been reviewing the trade of the machinist had its origin. It would be interesting to determine accurately, if that were possible, what is now the annual product of this new industry; but the census gives only the aggregate value of the machinery, tools, and implements in use, and the annual production of all manufacturing industries. From this source, however, we find that the annual product of all manufacturing industries per employee amounts to \$1988, a sum considerably in excess of what I believe would be found to be the product per employee in a manufactory comprising foundries and machine-shops. The last census gives the number of foundries and machine-shop establishments at 6475, the capital employed at \$382,798,337, and the number of employees at 247,754; and if we assume the annual product per employee to be \$1500, we shall have an annual production of machinery equal to \$371,631,000, which is probably a moderate estimate. The importation of machinery is so small compared with our own production that the cost has but little effect upon our market, particularly so as its design and construction are generally regarded as inferior to our own; but it is of interest to know that our average annual importation for the last five years has been \$2,512,417.

It is to be hoped that, with a more widely disseminated knowledge of the value of statistics, the coming decade will develop census reports from which, for the principal industries at least, an accurate knowledge of our production per operative may be determined.

Wm. Sellers

CHAPTER L

AGRICULTURAL MACHINERY AND IMPLEMENTS

KNOWLEDGE is not a matter of words: it is an acquaintance with things. Theories may present a seemingly formidable front, but they must ever yield before the battering-ram of facts. The farmer who hitched his small horse to the short end of the whiffletree to balance the large horse at the longer end may not have appreciated the stern philosophy of the failure of his scheme, but the failure itself was a demonstrated fact. Needless to say, he was not a farmer of the present day and age, to whom the laws of mechanics, as applied to his calling, are almost as familiar as to the inventor himself. The contributions of invention to the advancement of agriculture are as self-evident as cause and effect. These contributions — the things contributed — are familiar to the great farming public. This acquaintance with the various machines and implements designed for his use has given the agriculturist a knowledge that is power — a power that is seen not only in his own ameliorated condition, but in the generally augmented commercial prosperity of the nation and of the world. The universality of the value of important agricultural inventions is uniformly recognized by writers upon commercial and economic subjects. In 1869 Mr. J. J. Thomas published a book entitled "Farm Implements," and in the course of his introductory remarks said: "The great value of improved farm machinery to the country at large has been lately proved by the introduction of the reaper. Careful estimates determine that the number of reaping-machines introduced up to the beginning of the great Rebellion performed, while working in harvest, an amount of labor nearly equal to that of a million of men with hand implements. The reaper thus fills the void caused by the demand on workingmen for the army. An earlier occurrence of that war must therefore have resulted in the general ruin of the grain interests, and prevented the annual shipment, during that gigantic contest, of the millions of bushels of wheat which so greatly surprised the commercial savants of Europe."

In contemplating the subject of farm machinery and implements, one is struck by the infinite variety of useful inventions extant, and is at a loss to know where, within the scope of a brief sketch, the line shall be drawn between special mention and mere allusion covering the general field. Research in this direction, however, as doubtless in most other industrial lines, discloses the names of a few whose individuality has become so indelibly stamped upon the age as to entitle them to more than a passing notice. Aside from these apparently necessary exceptions, it is not the purpose of this article to dwell upon particular inventions, classes, or individual inventors, but rather to indicate in a comprehensive manner the growth and development of the specified art during the past 100 years, and to show or attempt to measure the accruing advantages not only to agriculture but to the commercial progress of this wonderful century.

There are no tangible figures relative to the early manufacturing interests of the United States. The government made an effort to secure data on this subject in 1810, and, under the direction of the Secretary of the Treasury, the marshals of the several States, and the secretaries of the Territories, began the work, but the returns were so irregular and deficient in specific particulars that they have never been accepted as possessing any value for the statistician. It may be said, however, that down to the beginning of the present century but little progress had been made in the improvement and development of agricultural implements. It is true that during the eighteenth century in Great Britain there were various spasmodic efforts at improvement which showed that inventors were dreaming of something better than was then in common use, but they either lacked

Eldridge M. Fowler.

capacity to make their new devices practically operative, or agriculturists lacked sufficient intelligence to appreciate and operate them. The first quarter of this century had passed before invention in this line had made any practical progress, and it was not until the middle of the century that manufacturers undertook a general advance, and began to push their product and arouse agriculturists to the advantage of improved implements. Then opened this modern period of rapid progress, development, and perfection. The movement began in this country, and Americans have maintained the lead ever since.

The centennial character of this publication suggests the fact that 100 years ago the patent on Eli Whitney's cotton-gin was two years old. As a factor in the acceleration of the national resources and wealth, its value can scarcely be overestimated. Referring to it, Lord Macaulay is reported as saying: "What Peter the Great did to make Russia dominant, Eli Whitney's invention of the cotton-gin has more than equaled in its relation to the progress and power of the United States." In 1791, just previous to the time of Whitney's invention, the cotton crop of the world was estimated at 490,000,000 pounds, of which the United States produced about one two-hundred-and-forty-fifth. As early as 1845 the total product had increased to 1,169,600,000 pounds, of which the United States supplied 1,000,000,000 pounds, or more than seven eighths. Other cotton-producing countries were slow to avail themselves of Whitney's invention, and were consequently distanced in the race to supply the world's increasing demand. In this connection it is interesting to note that in 1784 a consignment of eight bags of cotton, a total of about 1600 pounds, was seized at Liverpool on the ground that so large a quantity could not have been produced in the United States! A conservative estimate of the cotton crop of this country for the current year places it at about 9,500,000 bales of 477 pounds each.

The first need of the original agriculturist was an implement for stirring the soil, and for this purpose he fashioned a stick with a hooked end, which he himself drew. In time, when beasts were trained for the bearing of burdens and for draft, this stick was enlarged and drawn by them; later it was shod with iron, and through all the centuries down to a little more than 100 years ago it remained substantially the same, even among the most highly civilized peoples, being to this day in common use in Mexico and in other Latin-American nations. Some improvement was made in Great Britain during the last century in the form of plows, and iron was increasingly used in their construction, but the plow still in common use was the primitive implement, generally made by the farmer himself. The first American patent on a plow was granted to Charles Newbold of New Jersey, in 1797. The claim was for a plow of solid cast iron, excepting handles and beam, consisting of a bar, sheath, and mold-plate. It cut and turned over the soil very well, but farmers did not accept it because they thought that iron was poisonous to the land.

The man who laid the foundations of the modern plow was Jethro Wood. He gave it its present form and made it of cast iron, with share, shin, mold-board, and landside, the parts being common to any plow—that is, interchangeable. It was patented September 1, 1819. During the forties plow-making was carried on extensively in the Eastern States, but the demands of the Western and prairie States from 1850 and onward, and the use of chilled iron, expanded the industry and led to the many inventions and the perfection that have followed. Among the names that will ever be associated with the plow are John Deere, pioneer inventor and manufacturer, and James Oliver, whose perfection of the chilled plow was an important advance in this line of invention.

The first drag, or harrow, was the limb of a tree, with extending branches. This suggested the A form of drag with teeth inserted, and it, in turn, the square or oblong Roman harrow. These came down to the middle of this century, substantially unchanged. The first improvement in harrows was the revolving disk, for which the first patent was issued by our Patent Office to G. Page on August 7, 1847. Many and various have been the improvements in harrows since.

Hand dropping or sowing of seed was the common practice down to the middle of this century. A sort of drill plow was produced in Assyria long before the opening of the Christian era, and the Chinese claim the use of a similar implement some three or four thousand years ago. About 1730, Jethro Tull, an Englishman, produced a machine that was the prototype of the modern drill. By the end of the century, considerable advancement had been made in England, and a broadcast seeder mounted on a wheelbarrow had been invented. The first American patent on a seeding-machine was granted in 1799 to Eliakim Spooner, and several others were issued during the early years of this century; but nothing practical resulted until about 1840. J. Gibbons, on August 25, 1840, patented the feeding cavi-

23

ties and a device for regulating the amount delivered. Next, M. and S. Pennock, of Pennsylvania, obtained a patent March 12, 1841, for improvements in cylinder drills, a class of drills they largely placed upon the market. Patents on slide drills and "force-feed" drills followed, the first patent on the latter having been granted to Foster, Jessup & Brown, November 4, 1851. The feeding or dropping devices having thus been invented, various kinds of seeding-machines followed — drills, broadcast seeders, and combinations, etc., to be developed and perfected as the years passed.

The original cultivator was like the original plow, simply a hooked stick. This in time was developed into the hoe, and remained the common cultivating implement until this century was well advanced. Early in the eighteenth century Jethro Tull originated in England the "horse-hoe" system of cultivation. He sowed grain in rows, cultivating between them. To carry out his system he invented the horse-drill and the horse-hoe, or cultivator, with which to work between the rows. His system failed for the time, cultivating continuing to be done with the hoe, and sometimes by plowing between rows, until corn-fields began to be of considerable size, when the single-shovel corn cultivator for one horse was produced by some blacksmith, and later another shovel was added, forming the two-shovel plow. The latter was generally used in the prairie corn-fields up to 1860. April 22, 1856, George Esterly took out a patent on a straddle-row two-horse corn cultivator, which was the first in the invention of a line of implements in the manufacture of which millions are now invested; there being an almost endless variety of cultivators — hand and horse, single and double, walking and riding, shovel-bladed, spring-tooth, disk, etc.

Among the prehistoric implements that have been found are several forms of sickles and scythes for cutting grain. The earliest are of flint, but curved and shaped quite like the old sickle that our grandfathers used; the scythes being similar in shape, but larger, some having shanks for handles, or snaths. These were the implements with which grain and grass were cut, down to about fifty years ago. Of course, through the many centuries they were improved in form and material; the snath of the scythe was given the proper shape, and finally fingers were added, forming a cradle, early in this century. It is true that Pliny describes a crude stripping-header, as in use in Gaul during the first century of the Christian era, and several efforts were made to produce a grain-cutting machine to be drawn or pushed by horses, in England and in this country, toward the end of the last century and the fore part of this; but nothing practical came of these efforts.

The earliest demonstration of a successful reaper was made by Cyrus Hall McCormick in Virginia in the summer of 1831. His first patent was granted on June 21, 1834. Letters patent bearing date December 31, 1833, were issued to Obed Hussey, but the McCormick reaper had been operated in the field two years before Mr. Hussey claimed to have invented his machine. Both McCormick and Hussey built reaping-machines that did good, practical work. Hussey, however, was hardly strong enough for the struggle necessary for pushing a radical innovation; but McCormick zealously persevered, improving and perfecting his machine, building an increased number each year, and pushing their sale with untiring energy, until the demand so largely outran manufacturing facilities that in 1847 the plant was removed to Chicago and fully equipped for supplying the harvest-fields of the West.

In 1849 the United States Commissioner of Patents, referring to the McCormick reaper, said: "In agriculture it is in my view as important a labor-saving device as the spinning-jenny and power-loom in manufactures. It is one of those great and valuable inventions which commence a new era in the progress of improvement, and whose beneficial influence is felt in all coming time." Mr. McCormick exhibited his machine at the London Exposition of 1851, and after witnessing its field work the juries were enthusiastic over its success, it being openly asserted that this machine alone was worth the entire cost of the Exposition. In recognition of the value of Mr. McCormick's invention, it is worthy of note that in 1878 he was elected a corresponding member of the French Academy of Sciences, on the ground of his "having done more for the cause of agriculture than any other living man."

Since the invention and general introduction of the reaper, improvements have been many and valuable. Among those marking the progress of the development it should be noted that in July, 1851, Palmer & Williams were granted a patent on their self-raking reaper. During the fifties patents were also issued to John H. Manny, Walter A. Wood, Cyrenus Wheeler, and others, for improvements on reapers; to Louis Miller for important features of both reapers and mowers, and to C. W. and W. W. Marsh for the first practical hand-binding harvester, with which, later, the binder was successfully incor-

porated. The first patent on a grain-binder was granted to John E. Heath on July 22, 1850. Coming down, however, to the automatic twine binder, as in use at the present time, the McCormick device patented by Marquis L. Gorham, February 9, 1875, is the original successful invention. The early reaper has gradually developed into the modern harvester, and is now quite generally superseded by it. The range of the harvester's utility is also being enlarged, and we have a machine adapted to the successful cutting of rice, and another to corn and sugar-cane. Within the past decade some attention has been given to the Universal Harvester, designed for the simultaneous cutting and threshing of grain. It is built to cut from sixteen to forty feet, but climatic conditions are such as to preclude anything more than a very limited adoption, though machines of this type are used to some extent on the Pacific Coast.

Implements for mowing and reaping were originally of the same class, and mowing and reaping machines were thus classified in the Patent Office, so it is not known who first invented a machine intended solely for mowing. The early reapers were generally of the class known as combined—that is, they both reaped and mowed. William F. Ketcham was the first to build distinctively mowing-machines for the market. His first patent was granted on November 18, 1844.

Grain was first pounded out of straw by a stick, next by the flail, and then by cattle or horses on the "threshing-floor," and the larger portion of the grain in this country was thus threshed prior to 1840. The first successfully operated threshing-machine was the invention of Andrew Meikle, in Scotland, for which he obtained a patent in 1788. A fanning-mill was added in 1800, and it then became a complete separator, but it was very imperfect and was stationary—being run by water-power—and the grain was brought to it to be threshed. Threshers without separating devices were used in this country as early as 1825, but to Hiram A. and John A. Pitts belongs the honor of producing the first practical combination of threshing and cleaning, or separating, devices, all in one machine, and that portable. In 1834 they made the combination and successfully operated it. Their first patent was dated December 29, 1837. The Pitts Brothers laid the foundation of the threshing-machine industry, and they and McCormick, who was bringing forward his reaper at the same time, together laid the foundation upon which has since been built the whole structure of the modern agricultural-implement industry. It opened up great possibilities for improvements in other classes, and stimulated invention in all lines.

Corn-planters are strictly an American invention. Several patents on seeding-machines were issued by the United States Patent Office from 1799 down to 1836, when the records were destroyed by fire, and some one or more may have been granted for putting seed-corn into the ground. A patent was issued to D. S. Rockwell, March 12, 1839, for a corn-planter. Afterward other patents were granted, covering various devices and improvements in hand and horse planters, but it was left for George W. Brown to produce a practical and marketable machine of this type. His first patent was issued on August 2, 1853. The hinged marker was successfully attached by Jarvis Case, whose patent is dated December 1, 1857. The first patent on a check-rower was granted to M. Robbins, on February 10, 1857; but to Haworth Brothers is due the credit of making the check-rower sufficiently practical for common use and putting it on the market.

In haying tools and machinery, J. E. Porter's patents of 1872, on carriers, opened the way for a big industry. The Keystone Manufacturing Company were first in the field with a successful hay-loader, and to P. K. Dederick must be accredited the perfection attained by the baling-press.

In view of the fact that windmills for pumping purposes were very generally used in Holland several hundred years ago, it seems somewhat surprising that the farm wind-engine, as we know it to-day, has a history of only some two-score years. In 1841, a man named Wheeler, who was laboring as a missionary among the Indians in Northern Wisconsin, conceived the idea of a windmill for grinding grain and pumping water, but it was not until 1867 that his theories were embodied in a model of what is known as the "solid-wheel" mill. In 1854, Daniel Halliday and John Burnham crystallized their ideas of a sectional windmill, and, engaging at once in its manufacture, stimulated others, until now immense capital is invested in this branch of industry.

It is apparent that there are many other important machines and implements of this class well deserving more than passing note, but the scope of this article precludes any specific reference to them. Of incalculable value is the long line of portable engines, horse-powers, ditching machines, corn shellers, shredders, and huskers, cane machinery, potato planters and diggers, etc. Suffice it to say that in these various lines improvement is the watchword; and if our American inventors have not quite reached perfection, they are making commendable progress

toward it, and need have no apprehension of being superseded by inventors or manufacturers of other nations.

The number of establishments engaged in the exclusive manufacture of agricultural machinery and implements, as shown by the census returns of 1890, was 910; or, as specified in the "Government Bulletin," this is the "number reporting," and we can well believe that it is considerably below the actual total. These concerns reported an aggregate capital of $145,313,997, the number of hands employed being 39,580, receiving in wages $17,652,162. The value of the manufactured product, including receipts from custom work and repairing, was $81,271,651. Our foreign trade in this line of manufactures is increasing at a rapid rate, having grown from practically nothing at the time of the Rebellion to $5,027,915 for the fiscal year ending June 30, 1894, a forcible illustration of the fact that American genius and skill, American capital and push, are asserting their supremacy around the globe. The number of farms in the United States is given as 4,564,641, or 623,218,619 acres, worth $13,279,252,649. These farms were supplied with machinery and implements to the value of $494,247,467, this figure representing a gain of over twenty-one per cent. in ten years. It will thus be seen that the modern agriculturist is keenly alive to the value of either improved methods or implements looking to the bettering of his condition and the lightening of his labors. If he does not repeatedly say so in words, he puts it more forcibly in deeds. That he takes kindly to the manufactured products of inventive skill is seen in the gradual ratio of increase of the money annually expended for purchases in this direction. It is also seen in the wonderful increase of our country's cereal product, which has grown from about 600,000,000 bushels in 1840 to considerably more than 3,000,000,000 bushels as estimated for 1895. There has, of course, been a natural logical increase in our farm product, but it is safe to say that a fair percentage of it, as shown by the above figures, has been directly due to the benefits which invention has contributed to modern agriculture.

In the early colonial days, machinery was regarded as a special invention of the devil, and it was a bold step, taken by the Rev. Thomas Barnard, to preach his "manufactory sermon" in Boston, in the course of which he asserted that "an industrious prosecution of the arts of civil life is very friendly to virtue," assuring his hearers that such encouragement to manufactures as would enable them to produce at home what they were then importing from foreign countries would be the part of wisdom and prudence. It was nearly three quarters of a century later before the agricultural-implement industry gave even a hint of its ultimate magnitude, and the story of its wonderful growth during the past fifty years — were it told by a master who should picture all its brightness — would read like a tale of the Arabian Nights.

The invention, development, and marketing of our modern farm machinery and implements have directly advanced the cause of agriculture to a degree that our forefathers never dreamed of, fairly lifting it from the treadmill round of drudgery to the table-lands of thought, so that now, instead of being a mere matter of the application of brute force, its rich possibilities call into constant requisition the God-given attributes of intelligence and reason. In the United States there are more than 10,000,000 persons actually engaged in agriculture in its various branches, a number which far exceeds those employed in all other fields of labor, and in nothing is the progress of the farmer's calling shown so strikingly as in the wonderful improvement in the implements designed for his use. By the aid of these he has, within the last half-century, been enabled to increase the effective force of labor fully twenty per cent., which means an annual net gain to the agricultural community of probably not less than $200,000,000; and when it is remembered that the products of the farm present a most important figure in our commerce, our manufacturing, shipping, railroad, and kindred interests, it will be conceded that the advancement of agriculture means also the advancement of these industries, and a material augmentation of the general prosperity of the whole country, and of all countries.

Eldridge M. Fowler

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CHAPTER LI

STOVES AND HEATING APPARATUS

CAREFUL research into the history of the origin and evolution of stoves and heating apparatus develops the fact that advance in invention and manufacture has not followed isothermal lines, as would seem natural, but that the United States, from the inventive character of its people, has easily taken the lead, although in doing so it has not hesitated to appropriate all that was best and most useful in the systems that obtained in other countries. The vast geographical extent of our country, its various climates, and the complex character of its population have been reflected in the history and nature of this as of other great industries.

Stoves are said to have been cast for the first time in Alsace, France, in 1490, and as early as 1509 they were cast at Ilsenberg. The first casting known to have been made in America was a small round-bottomed kettle with a cover, made at Lynn, Mass., in 1642, at the first blast-furnace erected in this country. The jamb-stove was made by Christopher Sower, of Germantown, Pa., between 1730 and 1740. In 1744 Franklin stoves were made in Philadelphia.

Between 1752 and 1768 stoves of the box-stove order were made at Marlboro, near Winchester, Va. In 1760 Baron William Henry Steigel cast stoves at his furnace near Letiz, Pa., and was very successful. In 1786 heating-stoves of the box shape were cast in Philadelphia, and plates for these stoves were shipped to Providence, R. I., and to Troy, N. Y., where they were put together. The Conant stove was made at Brandon, Vt., in 1820. The plates for the Woolson stove were made at Brandon, Vt., and carted seventy miles to Claremont, N. H. The Woolson stove was also made at a later date in Massachusetts, Detroit, Mich., and in Cleveland, Ohio.

The character of heating and cooking appliances at any period is determined by the kind and price of fuel. At the beginning of the century wood was cheap and labor scarce; therefore the fireplace was made capacious enough to contain a large back-log which lay in the ashes at the rear, and in front of which was the forestick, resting on andirons. The space between these two logs was filled with smaller wood. The living-room in which this fireplace was located served for both kitchen and dining-room, and at night high-backed settees were arranged in front of the fire to intercept the heat, and prevent cold draughts from behind. The home idea of the fireside that pervades our literature had its origin in these early family rooms. The fireplace also served for cooking. Hinged to the right-hand jamb was an iron crane filled with dangling pot-hooks. It was pulled out so that pots and kettles might be hung on the hooks, and the crane was then swung back over the blazing fire. Potatoes were baked in the hot ashes. In the wall alongside the fireplace was built the brick oven, with its flat bottom and arched top, having an iron door in front. On baking-day, a wood fire was built inside of this oven, and when it was burned to coals and the oven thoroughly heated, the fire was neatly removed, and the bread placed on the oven bottom. In England, with soft coal for fuel, they still cling to the open fire, and do not take kindly to the substitution of close stoves. In the northern part of America the climate made it desirable to heat other rooms than the one in which the fireplace was located. The first effort in this direction was the jamb-stove. This was a cast-iron box built into the side of the fireplace so that one of its sides received heat from the fire, while the rear end, which could be closed with a door, opened into the room in the rear of the fireplace, which thus received some heat from the adjoining chamber.

In the early days churches were not heated, foot-stoves being used to keep the feet of the congrega-

tion warm. These consisted of sheet-iron pans about six inches square, in which live coals were placed, and these were enclosed in casings of metal perforated at the sides and top, having bails by which they were carried. In 1744 Benjamin Franklin devised a cast-iron open fireplace which stood out from the chimney and so caused the heat from its back and sides to be thrown into the room.

The six-plate or box-stove was the earliest form of the present heating apparatus. It was made from iron taken directly from the blast-furnace, and was very heavy. These stoves stood on an ornamental frame, and were made in this country as early as 1752. Early in this century cylindrical or oval stoves of sheet iron were made in Philadelphia, and also in New Hampshire, by Isaac Orr. This developed later into the oval regulator, with a draft-damper, opened and closed automatically by the difference in expansion of a brass rod and the sheet-iron stove-body. In 1836 James Atwater, of New York, made a stove with an illuminated case of cast iron and mica. It had inclosed flues, a check-flue, and a direct draft-damper. The Stanley square heating-stove, with return and exit flues inclosed in the four corners, was perfected about this time. In 1845 Dr. Bushnell invented a cylinder-stove with the inside lined with fire-clay, and having a pipe at each of the four corners, down which the heat returned to a hollow base, and thence went up through a pipe at the back.

Gas-burners or surface-burners next appeared in the order of time. These were both round and oval, and by perforated fire-pots, or perforated gas-rings at the top of the brick, the coal was more perfectly consumed than in any former device. They were mostly made of sheet iron; and generally the flues which returned the heat to the base were inclosed in the stove body. The most popular of these were the P. P. Stewart's oval and round parlor-stoves, first made about 1860, by Fuller, Warren & Company, of Troy, N. Y.

Base-burning stoves have now been long in use. The principle of these stoves is "to place the fuel in such a position that air to supply combustion shall come from one direction, and the fuel from the opposite direction, thereby causing the heated products of combustion to pass from the sides of the pile of fuel, instead of up through it." The magazine idea is first seen in the English patent of David Riz, 1770. Next came the patents of James Watt, in 1785; Pollock, in 1807, and Stratton in 1817 and 1822. Anthracite coal was brought into use in America between 1820 and 1830, being afterward used to a limited extent for heating in open grates. It was so difficult to prevent a fire kindled with anthracite coal from going out, that those who were interested in this fuel sought for an expert to devise the best method of burning it. Dr. Eliphalet Nott, President of Union College, of Schenectady, N. Y., had invented a box-stove in 1820, with which all the students' rooms in the college were heated; and as he was an acknowledged authority on the combustion of fuel, a small quantity of anthracite coal was sent to him. The result of his experiments was the construction of an illuminated magazine-stove of an oblong square section, lined with fire-brick. This worked well, but for the fact that when the cover was removed gas would escape and often explode. When a passage was made from the top of the magazine to the exit flue, which allowed the gas to pass off, the users would often carelessly leave the damper open, thus causing all the coal to become ignited. These defects rendered the new stove of no value.

Jordan L. Mott, Sr., a merchant of New York City, who in 1830 had become a manufacturer of stoves, in 1833 constructed a self-feeding base-burner. In this stove he introduced the burning of the chestnut size of anthracite coal in thin layers, fed from a magazine. Mr. Mott's stove contained the principle of the modern base-burner, as it is now used. In 1852 D. G. Littlefield, of Albany, constructed a self-feeding base-burning stove, which he improved in 1856; and in 1862 he made his "Morning Glory" base-burner, which had a very large sale wherever anthracite coal was used. The construction of this stove, employing chestnut coal, showed how anthracite coal might be burned successfully. In 1862 the "Oriental" base-burner was devised by Perry & Company, being similar to the "Morning Glory" construction. It had a great sale.

About this time the "American" base-burner was brought out by Van Wormer & McGarvey, of Albany, proving very successful. About 1863 Hailes & Treadwell, acting for Rathbone, in Albany, added a magazine to the revertible-flue gas-burner, which drew the flame away from the magazine, and heated the floor more than the direct-draft base-burners had previously done. In 1865 Hunt & Miller, of Hudson, produced a base-burner with very small mica windows opposite the grate. In 1871 James Spear, of Philadelphia, constructed his anti-clinker direct-draft base-burner, with a small illumination opposite the grate, and the same year W. J. Keep brought out "Keep's Side-Burner," which was the first stove that had been made with a full mica section both below and above the fire-pot.

Fuller, Warren & Company, who manufactured this stove, were of the opinion that "no one would admire mica windows opposite a dirty ash-pit," and therefore thought best to be very careful about putting it on the market. Perry & Company, of Albany, were watching the anti-clinker and the side-burner, and in 1873 put the anti-clinker grate and the full double illumination into a case of the graceful proportions of the American base-burner, and produced the "Argand" base-burner. The arrangement of flues in the Argand was the same as had been made by Elihu Smith, who did much to develop the base-burning stove. The Argand construction and shape were exactly what the people wanted. The Michigan Stove Company manufactured it on royalty in the West. The Detroit Stove Works made the "Crown Jewel" of the same shape, except that they sloped the lower windows outward. Fuller, Warren & Company in 1875 made "The Splendid" after the lines of the "Crown Jewel," and in 1876 the Michigan Stove Company dropped the "Argand" and made the "Garland." This type of round stoves held its own until 1880, when the Magee Furnace Company, of Boston, constructed a rectangular double illuminated base-burner, with an artistic ornamentation. This shape was followed by leading firms, but did not meet the approval of the masses, partly because the fire-box was square.

In 1884, the Michigan Stove Company brought out a stove with square base, round front, and nearly square sides, with a round fire-pot, and a round top surmounted by a dome, called the "Art Garland." This was the invention of Mr. Keep, who had removed from Troy, and had become the superintendent of the Michigan Stove Company. This stove was imitated by six of the largest firms the next year. The same year Smith & Anthony of Boston made the "Hub" base-burner, with a modeled ornamentation by Mr. Osburn, designer of the Low Art Tiles. In 1885, the Michigan Stove Company adopted the modeled style of ornamentation, which has since been used by the principal manufacturers. In 1887, Mr. Keep patented the use of an inturned mica section over the fire, with a reflector placed above it, in the "Reflector Art Garland" for the Michigan Stove Company. The patents were respected for about five years, but at present nearly all first-class houses have constructed stoves with the reflectors and the shape of this base-burner.

The first departure from the early brick oven was the tin reflector. When this was set before the fire the baking was done on shelves by radiant heat. In the brick oven the fire was placed inside. The first effort at improvement tended to place the fire outside the oven, so as to impart a continuous heat, and at the same time to make a portable stove which would warm a room by the heat escaping through its outside walls. The first cooking-stove was probably evolved by placing an oven in a box-stove. The James stove was the first of this kind of which we have any record. It was called a nine-plate. The oven door opened on the side of the stove, and the flues about it led the smoke up its sides and over the top to the pipe collar.

The Vermont "Historical Magazine" has this to say concerning the great change wrought by the introduction of the cooking-stove:

> In 1819, John Conant invented the Conant stove, and made the first one from castings obtained at the furnace in Pittsford, Vt. In 1820, Mr. Conant erected a furnace at Brandon, Vt., and the first blast was made in October. At this furnace was cast the old Conant stove, the first made in the State, and a great invention for the time, and which was the wonder of the farmer's kitchen. It was the inauguration of a new era in the culinary kingdom. The pleasant old fireplace, with its swinging crane of well-filled pots and kettles, hearth-spiders with legs, and bake-kettles, and tin bakers to stand before the blazing logs and bake custard pies in, all went down at once and disappeared before the first stove, without so much as a passing struggle. Stoves with ovens, but without boilers, etc., had been previously made to some extent. The State of Vermont was being supplied previous to 1819 by a house in Troy, N. Y., who had their castings made in Philadelphia.

The Conant stove had an oven above the fire, with a door in both ends, the front one being over the fire-door. Each side of the stove was extended so as to receive a pot which rested in the recess by its rim. This presented one side and a portion of the bottom of each pot to the fire. At the rear of the stove another chamber was constructed to hold a third pot, and this could be heated by an independent fire, if it was not considered desirable to heat the whole stove. The fire was still under the oven.

The Woolson stove, invented at Claremont, N. H., had the oven at the side of the fire-box, and by dampers the heat could be thrown under or over the oven. The top was flat, and there were several cooking-holes. The "Premium" succeeded, and was an improvement upon this stove. As an illustration of the change in the requirements of the trade, Mr. H. C. Woolson, a son of the inventor, writes: "When my father's stove was first made the farmers said it did not burn half enough wood,

but when it was laid aside the complaint was that it burned too much wood. A sheet-iron stove was invented soon after my father made his stove, called the 'Yankee Notion,' which was the beginning of all elevated-oven stoves." Experiments in oven-stoves showed that the fire underneath the oven heated the bottom too rapidly, and the fire at the side caused one side of the oven to bake faster than the other. This led to placing the oven at the rear, and on a higher level than the boiler-holes, which brought the heat uniformly against all parts of the oven. This also enabled the boiler-holes to be placed very near the floor, and brought the oven higher up than in any other construction, making it a very convenient stove to operate.

The next progressive step was Stanley's rotary cook-stove in 1833, a stove which had the cooking-holes and fire-box as low down as the elevated oven. The top revolved by a crank and cogs, so that any hole could be brought over the fire. Tin ovens were placed over the pots or sad-irons to retain the heat, and a tin cover was put over a rack on which were placed loaves to be baked, making a portable oven for the top of the stove. An elevated oven was attached to the stove when required.

The evolution of the cooking-stove did not follow in regular sequence, as would appear from the foregoing account. The Conant, and Woolson, and the elevated-oven were probably made at the same time. Mr. Giles F. Filley, of St. Louis, sheds light on the subject as follows: "A Mr. Hoxie, a Quaker, had gone from Philadelphia to Salisbury, Conn., where pig iron was made before 1812. He had no doubt used the ten-plate stoves, for he held that the heating of an oven from the under side was wrong, and that the fire should be on the top of the oven, and be made to pass around the same to heat it evenly in all its parts. Hoxie's first stove was oval in form, the fire passing down the two end flues, meeting at the bottom of the stove, thence to a chimney by a channel cut in the hearth of the fireplace over which the stove was placed. Hoxie then made a two-flued portable stove, the flues similar to those in the two-flued ranges now in use. He next made a stove with what is now called the three-flued principle. The stoves made by Hoxie were principally sold in the neighborhood of Salisbury, and they were hardly known outside of that place during his lifetime, which ended about 1820." J. G. Hathaway, who made a great stir in the stove trade, obtained a patent on his stove in 1837. He claimed to have invented the three-flue construction, but he afterward admitted that he had seen one of Hoxie's stoves. The Buck stove was invented by a Mr. Crowell, of Palmyra, N. Y.; but according to contract the patent was taken out in the name of Mr. Buck, in 1839.

P. P. Stewart's first patent was in 1838. The fire-box hung in the upper part of the oven, so that the heat from both sides and the bottom was thrown into it. The flame passed down in one sheet in front of the oven, then under and up the rear to the pipe collar on top of the stove. Stewart's large-oven stove was made in 1850, and was at first a three-flue construction, but he soon after adopted a sheet flue under the oven, and three flues at the back. Samuel Pierce about this time invented the curved plate, now generally used at the front of the oven, which threw the ashes from the grate into an ash-pit in the hearth. There have been no important changes in cook-stove construction since that date. Minor changes have been made to increase sales, such as Filley's gauze door, his return-flue construction, the various arrangements of reservoirs and grates, the methods of oven ventilation, and Buck's Stove Company's brilliant glass and enameled oven doors. Several innovations have also been introduced by Bridge, Beach & Company.

Royal Deane, of the Bramhall-Deane Company, N. Y., gives a number of facts regarding French ranges, or those made of wrought-iron and steel. Before 1850 a Frenchman, who, he thinks, was named Gillette, had supplied the Boston market with a sheet-iron range. The fire in this range was suspended inside of a sheet-iron casing in a basket grate, the cooking and heating being accomplished by radiant heat from the fire direct. The firm of Stimson Brothers, or Stimson & Son, of Boston, had also made similar ranges. About 1850 the firm of Duparquet, Huot & Moneuse, of New York, was established, and made a similar range, but later the oven was made a separate part of the construction, and flues were placed around it as at the present time. In 1855 John Van, of Cincinnati, placed on the market the first modern wrought-iron range, intended to be used on Mississippi steamboats; and since that date this branch of the trade has increased very rapidly.

Stoves were manufactured in Detroit during the thirties at the Hydraulic Iron Works foundry. In 1849 the writer of this paper, while learning the molding trade in this foundry, worked on repairs for Woolson stoves, and in this way had his attention turned to the subject of this manufacture, and in 1861, with his brother, James Dwyer, he established the first foundry in Detroit exclusively for

making stoves. In 1864 this concern was merged into the Detroit Stove Works, W. H. Tefft and M. I. Mills joining the company. In 1871 the present writer, with Charles DuCharme, George H. Barbour, and others, established in Detroit the Michigan Stove Company, and in 1881 his brother organized the Peninsular Stove Company.

Foundries for the manufacture of stoves exclusively were established at Troy and Albany at an early date on account of the superior molding-sand found there. In 1835 Joel Rathbone and Pratt & Treadwell conducted stove foundries in the latter city. Such foundries were also established at various points in the New England States. New York City possessed a number of stove foundries, and Jordan L. Mott was one of the first to use a cupola for remelting iron for stove manufacture.

About 1865 the competition of foundries located in the West became so sharp that eastern manufacturers were obliged to establish branch houses at Chicago to facilitate the delivery of stoves to their western customers. Later, eastern men began to move their entire plants to western points, with the result that at present Chicago is the center of stove distribution.

As the result of the efforts of Mr. John S. Perry of Albany, a meeting of stove manufacturers was held at Delmonico's in New York on March 6, 1872, with Mr. John S. Perry as chairman, and Henry T. Richardson as secretary. General Rathbone suggested that a permanent organization was desirable, and the following committee was chosen for that purpose: Messrs. Resor, Smith, Shepard, Rathbone, McDonald, Tefft, Patterson, Bradley, Greene, and Filley. This committee presented a draft of a constitution and by-laws which were adopted after discussion and amendments, an association being organized with John S. Perry as president; G. F. Filley, first vice-president; David Stewart, second vice-president, and Mr. A. Bradley, treasurer. John S. Perry held the office of president until 1874; Sherman S. Jewett was president until 1878; John F. Rathbone, 1879 and 1880; R. P. Myers, 1881; W. H. Whitehead, 1882 and 1883; Grange Sard, 1884 and 1885; Jacob L. Smyser, 1886 and 1887; George H. Barbour, 1888 and 1889; D. M. Thomas, 1890; Jesse Orr, 1891 and 1892; George D. Dana, 1893 and 1894, and Lazard Kahn, 1895. In 1886 D. M. Thomas was made permanent secretary and held the position until his death in 1895, with the exception of the year 1890, when he accepted a position with a manufacturing concern. He resumed the duties of his office, however, in 1891. T. J. Hogan succeeded him in 1895, having been secretary during the year 1890.

At the first meeting in 1872, Mr. Perry presented the following table, showing the number of stoves manufactured in the years enumerated:

Years.	Number made.	Gain per cent.
1830	25,000	
1840	100,000	300
1850	375,000	275
1860	1,000,000	167
1870	2,100,000	110

The following figures are furnished by T. J. Hogan, secretary of the association mentioned above, the National Stove Manufacturers' Association:

In 1870 there were 275 stove and hollow-ware manufacturers, consuming yearly 275,000 tons of iron. The volume of business in 1872 was $37,-600,000. The stove foundries in the United States January 1, 1895, were 215, with an estimated capacity of $35,840,400. The volume of business in 1892 was $34,578,300; in 1893, $30,035,700; estimated volume of business in 1894, $24,204,810.

The estimated capacity is divided as follows:

Connecticut	$234,000	Maryland	$720,000
Maine	324,000	New Jersey	100,800
Massachusetts	2,580,000	Virginia	216,000
New Hampshire	169,200	West Virginia	100,800
Rhode Island	421,200	Pennsylvania	6,062,400
Indiana	1,098,000	New York	6,776,000
Ohio	4,107,600	Georgia	111,000
Illinois	3,859,000	Alabama	120,000
Kansas	360,000	Kentucky	975,000
Michigan	3,480,000	Oregon	90,000
Minnesota	342,000	Tennessee	1,086,000
Missouri	1,540,800	Texas	45,000
Wisconsin	921,600		

The Stove Founders' National Defense Association was organized in 1886 with Mr. Henry Cribben, president, and D. M. Thomas, secretary. Mr. Cribben has been elected president each year. The office of secretary has always been filled by the secretary of the National Association of Stove Manufacturers. Committees from this association and from the Iron Molders' Union meet each year to decide upon prices to be paid for molding, and to adjust differences and avoid strikes. Through the efforts of this association no reduction in the wages of molders employed by its members was made necessary during the period of business depression extending from 1893 to 1895.

In 1713, M. Gauger, in a treatise on the construc-

tion of fireplaces, recommended the heating of air by means of a hollow back or wall of a fireplace. In 1744 Dr. Franklin invented a stove for burning wood, in the form of a box, of a greater distance from side to side than in depth, with an open front. The smoke escaped over the top of a flat chamber behind the fire, and passed downward between it and the real back of the stove, and thence into the chimney. This flat, hollow chamber communicated underneath the stove with a tube opening into the external atmosphere, and a quantity of air was thus passed through the flat chamber into the room, through small holes left in the sides. This was probably the first attempt to construct a hot-air furnace for supplying pure heated air to rooms. A patent was granted Daniel Pettibone of Philadelphia, in 1808, for stoves for rarefying, by heat, air for warming buildings. This system was soon after introduced in the Philadelphia Almshouse, and was used for heating churches and large buildings. In 1835 William A. Wheeler is said to have made at Worcester, Mass., the first warm-air furnaces that were made in New England. Gurden Fox, a grocer of Hartford, Conn., some time between 1835 and 1840 brought out a hot-air furnace which had a large sale. Other hot-air furnaces of an early date were the Blaney and the Culver. The old firm of Richardson & Boynton, of New York, put the Boynton furnace on the market at an early period.

In 1843 Mr. Henry Ruttan began his experiments in heating and ventilation, and later wrote a book on the subject. The first attempt to heat buildings with anthracite coal was made in a very crude way. The furnace was placed in the cellar, surrounded by an air-chamber of brickwork, and the gaseous products of combustion were carried through the building, passing through cylindrical drums on the upper floors and out at the top of the house.

The use of hot water in pipes for heating seems to be an invention of great antiquity. Seneca has accurately described the mode of heating by water in the Thermæ at Rome, which shows that the method of heating baths by passing water through a coil of brass pipes which passed through the fire was known prior to the Christian era. The application of this invention appears to have cropped up at various periods. In France, in 1777, M. Bonnemain used a coil of small pipes filled with water for the incubation of chickens. In 1817 Marquis de Chabannes introduced it in London for heating a conservatory, and also heated some rooms in a private house by means of pipes leading from a kitchen boiler. In 1822 a Mr. Bacon, also in England, introduced hot water for heating purposes, using a single pipe of large diameter, which was slightly deflected from a horizontal line, the hot water passing along the top of the pipe, which gave very imperfect circulation. Mr. Atkinson, an architect, suggested the addition of a separate pipe for returning the colder water to the boiler.

Hot-water heating came into general use in Canada a number of years ago, and the open-tank system seems to have been first used there; but this did not become a popular method of heating in the United States until recently. In 1842 the Perkins hot-water apparatus was introduced in New York and Boston from London, by Joseph Nason; and the business was conducted in both places by the firm of Walworth & Nason. One of the first houses warmed by the Perkins hot-water heater was No. 15 Ashburton Place, belonging to the estate of Ebenezer Melleken, and the apparatus was in 1892 doing good work after a use of forty-seven years. In a Perkins apparatus circular, issued in London about 1820, a heater spoken of as being the only one in the United States is recorded to have been in the residence of Colonel Thomas H. Perkins, Pearl street, Boston.

Hot-water heating has been extensively used in England and in Canada, but was not thoroughly appreciated by the people of the United States until within the past fifteen years. The Gurney and the H. B. Smith heaters were very generally used. During the last fifteen years this method of heating has become very popular, and there are a great number of good heaters on the market. Detroit has done much to introduce hot-water heating. The Peter Smith heater was the first. The Detroit Heating and Lighting Company in 1885 began constructing the Bolton Heater, which had previously been made in Canada. The Mouat was the next. The United States Heater Company has during the past four years done a large business, and the Peninsular Stove Company are heating many buildings by a combination of hot water and hot air, their system being considered equal to any in use.

William Cook, of Manchester, England, proposed in the middle of the last century the heating of houses by steam. In America the practice seems to date from 1841, in which year Mr. J. J. Walworth bought a small stock of wrought-iron pipe and fittings, which had been sent to this country by James Russell & Sons, of Wednesbury, England, to be sold on commission by James Boyce, who soon became discouraged by the small amount of business

done, and returned to England. The gas companies were just beginning to use wrought-iron pipe. One year after, Mr. Joseph Nason returned from England, bringing the Perkins Steam Heater, which had been manufactured in England since 1820, and the firm of Walworth & Nason was formed. In 1845 or 1846 Mr. Nason conceived the idea of using small wrought iron pipes, three quarters to an inch in diameter, for warming buildings with steam. The first building warmed in this way was the Eastern Hotel, of Boston, and the first factory was the Burlington (Vt.) Woolen Mill. The steam-fitting in the factory was done by N. H. Bundy, the inventor of the Bundy radiator. For many years every steam-fitting firm in this country could trace its origin to the old shop of Walworth & Nason, through either one or two removes.

The improved methods of heating buildings by steam and of ventilating them by "fan blowers," now so extensively used throughout the United States, owe much of their development to James J. Walworth. It was in 1841 that he entered into partnership with his brother-in-law, Joseph Nason, and established the business of steam and hot-water warming and ventilating buildings by radically new methods. In 1844 the construction of apparatus for warming buildings, especially manufactories, by steam, was begun and rapidly extended. Immediately following this came a new system of ventilation by the use of the "fan blower," propelled by steam-power, which was and is used in conjunction with the system of steam-heating. Though J. J. Walworth has been the business head of the concern, yet as an engineer in steam-heating he has designed and executed many important works. Mr. Nason retired from the firm in 1852, and at present the Walworth Manufacturing Company owns an extensive steam-heating plant at South Boston, employing there and elsewhere upward of 800 workmen.

In 1846 Mr. Thos. F. Tasker, Sr., of Philadelphia, introduced the first closed apparatus returning the water of condensation to the boiler, and thus keeping up the circulation for heating purposes. His firm, Morris, Tasker & Morris, became very prominent soon afterward, in both steam and hot-water heating, being also manufacturers of pipes and fittings. This establishment subsequently became widely known as Morris, Tasker & Company. They made the first wrought-iron pipe that was made in this country.

Men who have been prominent in the introduction of steam and hot-water heating apparatus are Henry B. and Edwin Smith, John H. Reed, John H. Mills, and George B. Brayton.

Cast-iron radiators have been extensively manufactured in this country. The first we have record of is the N. H. Bundy radiator, and after that the Gold Pin radiator. The Gurney Manufacturing Company and a large number of others are making radiators, probably the largest concern being the American Radiator Company, which controls two extensive plants in Detroit and one in Buffalo.

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Jeremiah Dwyer

CHAPTER LII

PLUMBERS' AND STEAM-FITTERS' SUPPLIES

IT is through the agency of the plumber and sanitary engineer that life in cities, under the healthful conditions which govern it at the present time, is made possible. Though to the ordinary layman the work of the plumber may be less obtrusive, he really deserves a much more prominent position as a benefactor of communities than his fellow-craftsmen of the building trades are disposed to accord to him. The architect may prepare plans of edifices, the symmetry and beauty of which excite the pleasure of the eye, and his more mechanical co-laborers, the mason, the brick-layer, and the carpenter, may follow his tracings with the finished skill in the acquirement of which their lives have been spent; these create a habitation. But to the man who interweaves, as it were, his efforts with theirs, who provides sanitary appliances after a fashion compatible with the sternest laws laid down by the dictators of public health—to this man, the aim of whose life is to provide safeguards insuring his fellows against all danger of infection from that most insidious enemy of human life, the microbe bred by careless or imperfect domestic surroundings, is due a meed of gratitude but seldom forthcoming, because the reasons for it are so slightly understood.

Engineers, architects, and health officers accomplish much by their influence with individuals and by the exercise of their professional and official functions. They reach, however, only a limited portion of the community, while the plumber makes his influence felt on every hand. A certain trust is thus imposed upon him, which raises the better and more conscientious element of his occupation to a higher plane than is usually awarded to the followers of mechanical pursuits, as it has converted the calling itself into what enthusiasts on the subject might be tempted to denominate one of the fine arts. The word "plumbing," derived from the Latin *plumbum* (lead), meant originally to seal or repair with this metal. In the earlier ages lead was the material most favored for such purposes, owing to the ease with which it could be manipulated. Lead pipes were used to some extent by all the nations of old, and were invariably utilized in the ancient cities of Asia, Egypt, Syria, and Greece for conveying water under pressures too great for pipes made of earthenware. These pipes were made from sheets of lead rolled into the form of cylinders and soldered at the edges.

When the improvement in plumbing fixtures is compared with that of other materials used in mechanical pursuits a curious disproportion in the relative time that has been required for this development is revealed. Almost the entire history of progression in this department is covered by the past fifty years. Hardly a half-dozen plumbers were known in New York a half-century ago, and all these were men who fashioned in their individual workshops the somewhat crude fittings they supplied. After the completion of the Croton Aqueduct in 1842, however, the necessity for durable pipes and fittings began to be felt, and this led to the establishment of manufactories of plumbers' supplies. At first these concerns were engaged almost exclusively in the manufacture of lead pipe, sheet lead, or iron pipe. In the earlier part of the century, wooden pipes, or logs bored out, were used for conveying water through the streets. This was under the old Manhattan system. There was at that time, and is there yet, a tank in Reade Street for maintaining which the Manhattan Bank received its charter.

A modern chef would regard with curious contempt the kitchens of that day, though their occupants doubtless thought them adequate for all purposes of the culinary art. In contrast to the elaborate arrangements now in vogue for producing every degree of temperature desired, there was then the ordinary kitchen range with its water-back con-

Jordan L. Mott.

trivance for heating water, which, however viewed by modern eyes, was then regarded as being almost the veritable culmination of that half-century's development in domestic apparatus. The same principle applies in ranges to-day, and is in general use in private houses, although for hotels and other large buildings special appliances for heating water, independent of range connections, have accompanied the increased magnitude of such structures. The first kitchen appliance independent of the range, with its water-back and boiler connections, was a sink used in the kitchen, with the usual hot and cold water faucets over it. This for many years comprised the entire plumbing of an ordinary dwelling. The next feature was a bath—a wooden box lined with lead, a primitive and unsightly fixture. Following that came cast-iron bath-tubs, painted inside and out, and next a box lined with copper, which was the favorite bath for many years.

A quarter of a century ago was commenced here the manufacture of porcelain-lined bath-tubs, which for a long time were brought out exclusively by the company of which I am the head. To-day similar goods are made in various parts of the country by other concerns. The most popular and elegant tub —the very acme of perfection in bathing apparatus, in fact—is one of solid porcelain, which has become almost indispensable in the finest plumbing. These goods were, until a year ago, always imported from Europe; but since that time one of the most enterprising potters in the United States has so perfected this variety of ware that the American article to-day stands on an equal footing with the world's production. There is practically no expense to which one may not go in this direction, should he feel so disposed, and some of the private bath-rooms in the homes of modern millionaires could compete in point of beauty with the famous public baths of ancient Greece and Rome.

In the possession of our house is a Dresden-china bath-tub, the only duplicate of which is owned by the emperor of Germany. It is comparatively simple in design, and betrays but few evidences of the value put upon it—$3000. It is seldom, however, that extravagance extends thus far with this particular article. As a rule it is more generally distributed throughout the bath-room; and hand-painted tiles, which constitute the material for walls and floors, come in for a fair portion of the financial outlay, much fanciful decoration being permitted with these. Then the more immediate toilet accessories are to be considered, and among these are found onyx and variegated marble slabs with brass supports, plated with nickel, silver, or gold, and furnished with the most elegant Cauldon-china basins, painted by prominent artists. These adjuncts themselves constitute an important item of cost in the equipment of the thoroughly up-to-date bath-room.

In examining the subject of domestic sanitation it is worth while to note that while the expense of the plumbing of the average first-class dwelling of thirty-five or forty years ago could be computed at $250, this work to-day may be reckoned, in the majority of instances, at from $2000 to $6000, according to the size of the building and the fancy of the owner. As has been aptly observed, "Look out well for the health-rate, and the death-rate will lose its significance." Doctors for many centuries had the monopoly of what little knowledge existed of the conditions affecting public health; but of late years the Dwelling Reform Association of New York, American Public Health Association, Public Health Association of New York, and similar organizations in other large cities throughout the Union, together with the architect, the plumber, and the inventor and manufacturer of plumbers' supplies, have done more to reduce the death-rate from zymotic disease in our large towns and cities than probably the doctors have themselves.

As a part of the general sanitary system now to be considered, each house has its own network of pipes which convey the refuse of the basins, sinks, and closets to the general sewer. It is obvious that any leakage or deposit from these would nullify the purpose for which they were designed. The air within them must also be kept out of the dwelling by placing a water-trap at every opening through which sewage is to enter the pipes, and by making all internal pipes gas-tight. It is necessary that a current of fresh air have free access to the pipes, that the filth within them may be oxidized; and the air of the sewer outside must be rigorously shut off from that of the pipes within the house. This secures freedom from contagion from without, and the water-trap, as previously mentioned, furnishes protection against the passage of gas within through openings which admit of the entry of water.

The inverted siphon, which is sealed by water lying in the bend, is almost universally regarded as the simplest and best form of trap. True, inventors are appearing from time to time with other propositions in the way of a seal, but a better device hardly seems possible. A separate, distinct trap is placed in the house-drain to disconnect the main sewer from the house. This will not insure perfect security, how-

ever. Practically a distinct trap is required at each basin or other fitting, its function being to shut out the air of the house-drains from the rooms. The soil-pipe is ventilated by a current of air which flows upward, and must always extend to a point above the roof. This, together with the ventilating of each trap, insures the most perfect immunity against the accumulation of sewer-gas within the pipes that is known. Sometimes the additional flushing received by a soil-pipe into which the refuse of both a water-closet and a bath or wash-basin is discharged works rather as a benefit, and it may be contended that plumbing-work after the ideas just set forth, with proper traps, light and ventilation, good workmanship and first-class material, is all that is necessary to insure perfect safety from contagion.

A bedroom basin is usually made perfectly safe by leading its waste-pipe into the ordinary drain-pipe which connects with the sewer, and which must be protected by a water-seal, itself ventilated to prevent siphonage. It is a good general rule to have all plumbing fixtures ventilated in the same way. Occasionally rain-pipes are utilized as ventilating continuations of soil-pipes and waste-pipes. This should never be, for these pipes terminate under the eaves, a point where the drain-air is likely to be carried back into the house.

All drain-pipes should be made of iron. Lead pipe is affected by hot water and is often destroyed by rats. Clay decomposes and is easily broken. Two grades of soil-pipe are known to the trade—common and extra heavy. The common pipe, if certain conditions exist, can be trusted to serve for a considerable length of time. The heavy-grade pipe is the safest to select, however, and its diameter is a leading point of importance, as the quantities of water usually proceeding from bath and accumulating fixtures will, as a rule, flush a four-inch pipe better than one of larger size. Every joint of the soil-pipe should be made with a view to its being tested under pressure. Iron, as already indicated, is preferable in pipe to any other material. With the introduction of sewers generally the manufacturers in New York for some time supplied every section of the United States with iron pipe. The custom of tarring pipes cannot be too strongly condemned, as imperfections may exist which cannot be discovered after this has been done, but which manifest themselves after the pipes have been put into actual use and when it is too late to remedy them without great expense.

In the interests of good ventilation it is best to continue the soil-pipe and all vent-pipes to a point above the roof without any reduction in diameter. That the greatest care must be exercised in the manufacture and the adjustment of this class of pipe will be appreciated when it is stated that any want of air-tightness in drains or soil-pipes within a dwelling leads to the pollution of the air, both by indraft as well as by diffusion. A common method of testing such leaks as may admit foul air is to fill the house-drains, soil-pipes, and the rest with smoke from cotton-waste soaked in oil. The escape of these unpleasant fumes by other than the proper channels is readily detected. In occasional instances, too, the lower end of the pipe is stopped and the pipe itself is filled with water, the fall of which, of course, denotes an imperfection somewhere.

I have already referred briefly to the subject of traps, which, above every other branch of the more practical part of plumbing, causes the most vexation, and continually presents a problem that every aspiring sanitary engineer feels called upon to cope with. Few there are who have shrunk from charging this barrier, and but few of these, in turn, have failed to contrive some sort of a trap that for the nonce, at least, seemed to combine the essential features of which the plumbing world has been so long in search. In general, though, from its simplicity and practical utility, the system of back ventilation, indorsed by all the boards of health, is believed to be the most efficacious and satisfactory in existence.

In any article dealing with this subject attention must necessarily be directed to the progress which has been made in the construction of water-closets. It is with this division of plumbing more than any other, perhaps, that the question of general public health is most intimately concerned, and upon this point particularly have the manufacturers of plumbing fixtures brought all their inventive faculties to bear. Water-closets, apparently, were of as early origin as definitely constructed baths. In the history of Rome we find records of some which were designed in gold and silver. It is contended that traces of others were found in the ruins of Pompeii, and that they even existed in Egypt. Fosbroke, writing on this subject, speaks of closets in the palace of the Cæsars which were adorned with marble and mosaic, and which were provided, apparently, with complete drainage by water.

Throughout Europe, however, the subject seems to have received but slight serious attention until the eighteenth century. The first English patent for a water-closet was issued in 1775 to Alexander Cummings, a watchmaker in Bond Street. This closet

had a sliding valve between the trap and bowl, and here we find the first recorded instance of a siphon-trap being used in this connection. In 1778 Joseph Bramah received a patent for a closet with a valve at the bottom of the bowl, working on a hinge. Bramah's closet was the forerunner of a large number of inventions founded on the same general principles as the first, and in most respects but slight improvements over that one. A valve closet supplied by a tank, the hopper of which was flushed by pressure on the seat, was patented in 1792. No patents were issued for water-closets in America until 1833, nor does it seem that previous to the nineteenth century they were considered as coming within the province of the plumber at all. At the present day we have for consideration valve closets, pan closets, plunger closets, hopper closets, cistern closets, siphon closets, and latrines. A score or so of years ago the pan closet was the type generally in use. Then came the valve and plunge closets, which have been superseded by the siphon closets. The valve closet takes its water from the main service-pipe, and cisterns are not usually required with this class of closets. A cistern closet differs in that its water supply is taken into the cistern direct from a main or a tank, and is released into the bowl by a system of valves and pulls. In the material of construction water-closets have followed the general trend of toilet furnishings, and are now made mostly in one piece and of glazed earthenware. Next to the water-closet, urinals are of vital sanitary importance, but their general construction and principles scarcely require extended discussion.

Thus it will be seen that never in history have plumbers had so much to do with the health of the families in our large cities as now, nor have they ever so well understood the principles of internal plumbing-work as at present. The knowledge of sanitary work is spreading rapidly, and to keep abreast of his trade the plumber has to educate his eyes as well as his hands; for it is not enough that he becomes a skilled hand-worker—he must become an intelligent head-worker as well.

An almost incalculable advantage now exists in the fact that even in the cheapest flats all kinds of closed plumbing have been superseded by open work, with no boxed fixtures or pipes. This is to be commended on account of its cleanliness, healthfulness, and availability in event of the necessity of repairs. Much of the progress made by the plumber has been due, without doubt, to the intelligent action of the boards of health. When it was definitely felt that this aid and coöperation were being furnished, the efforts of the better class of plumbers were strengthened and stimulated. To Mr. John Demarest, more than any other inventor, the public is indebted for the best plumbing fixtures known in any section of the globe. Many of these he himself has patented, and his entire career has been fairly illuminated with repeated successes in the devising of appliances to conform with the consensus of opinion expressed by the most capable sanitary engineers of modern times.

In proceeding to the second division of the subject I might remark at the outset that in these days it would be considered about as sensible for a man to contemplate the construction of any building of consequence without the aid of the workmen who fit the stone and lay the floors as to eliminate the steam fitter from his calculations. But few American industries have grown with such rapidity as this one, which has pushed ahead at a pace parallel with the manufacture of wrought-iron pipe. With the latter, too, its progress has been almost inseparably connected, for had not the production of wrought-iron pipe by perfected machinery and at a reduced cost occurred at the time it did, the development of steam and hot-water heating would have been greatly retarded. This growth may be said to date practically from 1840, though it did not assume proportions of consequence, relatively to the great industries, until after the close of the war. The earlier developments of the industry were largely assisted by Joseph Nason, of New York, and J. J. Walworth, of Boston.

Attempts at steam heating had been made in England by the employment of the Perkins system, in which very small pipes were connected with boilers, on the calculation that a high temperature would thus be generated. Sometimes this temperature became sufficiently high to elevate also its environments, after a most unexpected and distressing fashion; and because of this liability to explosions, as well as through its irremediable extravagance in the consumption of fuel, it was finally abandoned. At the period referred to it is probable that not twenty buildings in New York City were heated by steam. With the introduction of low pressure, the early development of which was greatly assisted by the two gentlemen mentioned, a change became almost immediately apparent. Low "pressure" meant practically no pressure at all, and possessed economical advantages hitherto unheard of. It was durable in that there was practically no wear upon the apparatus, and no fuel was wasted in generating high temperatures.

All of this was brought about, of course, by successive inventions and improvements. Though the two are included under the one title now, steam heating really preceded heating by hot water in pipes. The first boilers set up were similar to those that had been used for power purposes. They were made from wrought-iron. Radiators followed quickly, being constructed from wrought-iron tubes, both vertical and horizontal; but as low-pressure work came into more general favor other forms of radiators in sheet-iron were adopted, chiefly because of the low rates at which they could be sold. They lacked durability, however, and at last their use was abandoned. About 1865 the attention of manufacturers was directed to the construction of heating boilers and radiators from cast-iron; and though for a time progress in this direction was slow and the sale of these goods limited, it had assumed by 1880 proportions of fair size, and since that date has expanded with such rapidity as to make the manufacture of steam and hot-water furnaces one of our most important industries. A number of American manufacturers, in fact, are exporting goods of this description, and find that they can successfully compete with foreign makers. Because of the development of hot-water and steam heating, also, a strong impetus has been imparted to an auxiliary occupation—the making of such hardware goods as bolts, nuts, washers, gauges, facings, and various tools—which represents large investments of capital and on which the success of the main industry largely depends.

While the advancement in supplies for steam and hot-water heating has not hinged absolutely upon the development of the modern office building, it is undeniably true that this institution has constituted the most important factor in its increased prosperity, and has added enormously to its growth. The boilers used for this purpose are almost always of wrought-iron or steel, owing to the fact that in nearly every instance high pressure is used on the boilers for the running of elevators, electric lights, and for pumping. In a large number of these buildings the exhaust steam from the engines is alone sufficient for all heating purposes, and where it is not, a reducing pressure-valve is used, so that the pressure in the distributing pipes and radiators rarely exceeds five pounds, and the water condensation is returned to the boilers by automatic devices of various kinds, the manufacture of which occupies the attention of several large factories.

It is safe to state that in 1840 the amount of trade in this line did not exceed $200,000 per annum, and that not more than $75,000 were invested in it. In 1860 the trade had increased to about $2,000,000 per annum, which represented a capital of about $500,000. By 1880 these figures had increased to an annual trade amounting to $15,000,000, the capital behind which was $4,000,000; and at the close of the season of 1895 I can safely assert, I believe, that this industry has expanded in its yearly transactions to between $80,000,000 and $100,000,000, and that the invested capital will amount to $50,000,000. As an illustration of the rapid development of certain branches of this business it may be stated that while in 1870 only 8 firms were engaged in the manufacture of house-heating boilers, in 1880 there were 18; in 1890, 63; and for 1895 the number is estimated at 150.

The manufacture of cast-iron radiators has kept pace with that of the boilers. Only from 250,000 to 300,000 feet of radiators were cast in 1870, while in 1880 the output was little less than 2,000,000 feet. By 1890 it had increased to between 6,000,000 and 7,000,000 feet, and for 1895, as far as reports can be gathered, close to 18,000,000 square feet of surface will have been cast. The lowering of the cost of production has been a very material factor in the progress of this trade; in fact, it may be said that the reduced cost of steam and hot-water heating had a very sensible effect on its growth generally. As an illustration of this we may revert to 1880, when radiators were sold at thirty-eight and forty cents per square foot, figures which by 1895 had dropped to from sixteen to eighteen cents per foot for the standard sizes.

In other branches of this industry, as well, have occurred reductions as great proportionately to the cost of production. This is most notably the case in the manufacture of iron pipe and brass valves. These reductions have been brought about by improved methods of manufacture, better systems of management, and by largely increased trade, which permits business to be done with a smaller margin of profit.

In the foregoing, reference has been made at more or less length particularly to the culinary, bath, toilet, heating, and supply and waste pipe systems; but there are one or two subjects that have only indirectly been touched, among which one of the most important is ventilation or pure air. The outside air, as is well known, contains carbonic acid varying between 3 and 6 parts in 10,000 volumes; but in close places, such as crowded buildings, this rises to the extent of even 25 volumes in 10,000 of air. It has been experimentally proved that

when the heat is excessive organic matter charging the air of crowded places rises in amount as the carbonic acid increases, so that we have a foulness of the air, or, as it may be termed, want of ventilation. The sanitary plumber must fully understand this, just as he must also know that wherever there are sewers there is certain to be sewer-gas, which, when it finds its way into houses, becomes a deadly enemy to the human race, and the source or promoter of nearly all the so-called zymotic diseases. To abate this evil has been one of the greatest problems which the modern sanitary plumber has had to encounter, and which he has now happily solved for the benefit and welfare of the millions who live the artificial existence of our large cities. The wise and exact observance of all these sanitary laws and regulations by our plumbers in their work has within the past quarter of a century materially reduced the death-rate in our larger cities. Thus it will be seen that the work of the practical or sanitary plumber demands high and peculiar qualifications. His ordinary work is easily learned, but the scientific or sanitary part requires careful study. There are four things in a building which cannot be sacrificed to economy. They are the foundations, the roof, the plumbing-work, and the apparatus for heating. The two essentials first mentioned are usually secured at any cost; but the attempt to economize comes in the plumbing-work and furnace. As time goes on and the importance of the plumber's work comes to be still better understood, the vital interests affected by this false economy will be realized, and people will come to appreciate that the best way for all concerned is to pay the plumber a fair price and hold him to a strict account for the quality of the work.

In closing this article it may be interesting to show by figures the exact importance of the allied industries under discussion. The following tabular statement gives the number of plumbing and gas-fitting and plumbers' supply establishments, with the invested capital, the value of the product, etc., in thirty-seven of the principal cities of the Union, taken from the census reports for 1890:

PLUMBING AND GAS-FITTING AND PLUMBERS' SUPPLIES, 1890.

	Plumbing and Gas-Fitting Establishments.				Plumbers' Supplies.		
	No. Estab.	Capital.	Employees.	Product.	No. Estab.	Capital.	Product.
Atlanta, Ga	4	$44,050	105	$205,892	....	....	....
Baltimore, Md.	116	299,637	515	799,525	4	$295,819	$495,500
Boston, Mass	251	886,860	1,887	3,250,086	3	78,100	73,800
Brooklyn, N. Y	327	1,307,356	2,321	4,137,514	10	611,650	546,750
Buffalo, N. Y	63	673,569	815	1,360,070	....	....	....
Charleston, S. C.	14	27,862	42	54,825	....	....	....
Chicago, Ill	278	1,550,718	2,586	5,608,857	6	1,255,346	1,248,404
Cincinnati, O.	114	381,970	674	1,455,915	5	149,400	363,227
Cleveland, O.	45	225,980	453	783,926	....	....	....
Denver, Colo	8	44,450	72	181,860	....	....	....
Detroit, Mich	58	363,609	477	913,503	4	110,552	275,972
Galveston, Tex.	6	35,465	20	57,300	....	....	....
Indianapolis, Ind	12	63,720	115	184,165	....	....	....
Jersey City, N. J.	37	156,707	233	401,712	....	....	....
Kansas City, Mo	27	306,087	527	1,155,254	....	....	....
Louisville, Ky	40	138,249	286	418,613	....	....	....
Memphis, Tenn.	10	222,450	192	399,850	....	....	....
Milwaukee, Wis	39	437,712	612	927,024	....	....	....
Minneapolis, Minn.	33	442,847	647	1,232,541	....	....	....
Mobile, Ala.	7	14,165	33	43,860	....	....	....
Newark, N. J.	88	547,469	774	1,352,845	....	....	....
New Haven, Conn.	35	196,450	312	535,526	....	....	....
New Orleans, La.	16	182,883	158	329,748	....	....	....
New York, N. Y	769	2,705,093	5,537	10,304,253	17	1,408,954	2,345,383
Norfolk, Va.	7	37,305	54	61,423	....	....	....
Omaha, Neb.	20	243,700	310	728,696	....	....	....
Philadelphia, Pa.	498	2,612,597	2,975	5,701,478	15	1,401,675	1,100,031
Pittsburg, Pa.	27	136,407	173	279,380	....	....	....
Portland, Me.	16	95,625	116	240,892	....	....	....
Providence, R. I.	46	177,319	251	441,565	....	....	....
Richmond, Va.	28	315,895	271	495,850	....	....	....
St. Louis, Mo.	124	581,067	1,047	1,651,169	....	....	....
St. Paul, Minn.	35	364,835	477	1,075,827	....	....	....
San Francisco, Cal.	116	393,847	824	1,660,346	3	97,550	169,600
Savannah, Ga.	11	27,650	46	80,020	....	....	....
Syracuse, N. Y	14	154,300	172	373,259	....	....	....
Washington, D. C.	86	467,735	646	1,130,574	....	....	....

Thirty years earlier the census reports for 1860 divided the plumbing business and its branches into four general classes, reporting them as follows:

	Number of Establishments.	Capital Invested.	Cost of Material.	Employees, Male.	Annual Wages.	Value of Product.
Plumbing materials	1	$14,000	$26,905	35	$7,200	$40,000
Plumbing	3	3,500	5,172	6	2,580	9,200
Plumbing, etc.	4	22,100	20,200	42	15,900	50,300
Plumbing and gas-fitting	163	636,800	694,456	1,015	389,910	1,599,420

As showing the material increase since then, each one of a half-dozen of our principal cities exhibits in 1890 a larger value of product than did the whole country in 1860. With these figures to demonstrate its growth, and its own achievements to vouch for its worthiness, the trade of the plumber is one to which the future can only mean progress. Much has been done in fifty years, as I have shown; but more remains to do, and the next century will see the fruition of this one in the enlarged scope of new and changed conditions.

Jordan L. Mott

CHAPTER LIII

BUILDING MATERIALS

THE improvement in the art of building indicated by the variety of building materials, in iron, stone, clay, and wood; the machinery for their production; the skill with which these materials are used singly and in combination; the appliances for rapid construction; the devices for the conveniences and comfort of the occupants of buildings; and the artistic treatment of the interior and exterior of edifices, is self-evident to any person who compares the structures erected within the past few years with those put up less than a quarter of a century ago. These improvements in the art and science of building may be said to have been achieved within the business period of a single lifetime, without going back to the time when brick, stone, iron, and wood were worked into shape by laborious processes, afterward being used in the most commonplace manner, and when almost everything in which artistic effect was sought had to be imported from Europe, or the skilled labor to produce it had to be specially brought from the old countries. There are still standing in the lower sections of the city of New York dwelling-houses erected a century ago, old office buildings proudly named after owners who have passed away in the natural course of events, and old hotels that were once looked upon as marvels in their way. And yet many things that appeal to the eye and receive admiration as component parts of new buildings cannot strictly be classed as building materials, however essential to artistic effect or to comfort and convenience such things are. Decorations in oil and water colors on walls and ceilings, hangings of paper, leather, and other materials, electric lighting, steam-heating, and even the elevator, without which the modern high building would be impracticable, are among these.

The height to which many new buildings are carried indicates the greatest advance in the art of construction, for such edifices represent principles untried twenty years ago, and have for their basis the use of iron or steel for the support of the floors, instead of masonry, reducing the walls to a mere inclosure for keeping out inclement weather, and for protecting the ironwork incased in them from damage by fire. Twenty-five years ago a six-story building was considered very high; but passenger-elevators came into use, adding value to the upper stories. Ten and eleven story edifices followed. With solid masonry the thickness of a wall is regulated by its height, tapering by stories from the bottom to the top. Under this method the great thickness of the lower portions of the walls occupied the most valuable space for rentals, and with a height of ten or eleven stories the greatest practicable limit seemed to be reached. No more of the area of a valuable lot could be given up to the occupancy of brick walls. Suddenly and simultaneously a number of architects and engineers grasped the idea that metal columns could be carried up to any desired height, having girders between on which to carry the floors and the requisite amount of masonry as an outside protection. Thus an edifice could be elevated to the clouds, and, irrespective of height, take up far less of the area of a lot than would be required by the old-fashioned method of solid brick walls. Fifteen, twenty, and twenty-five story buildings quickly followed, and it is conceded that structures 500 feet high, or of any height whatever, can be safely erected on this plan.

The use of a framework, or, as it is generally termed, a skeleton, of iron or steel, with curtain-walls supported on girders placed between the columns, the latter and the girders carrying the floors in addition, is an American novelty, notwithstanding it has for its immediate prototype the cast-iron fronts with column standing upon column. The first cast-iron front ever erected in the world was put up in New York in 1848; yet that was but a repetition of iron columns and lintels long previously used as a substitute for stone and brick to the extent of a

single story. The skeleton, as used in the lofty buildings, is simply an evolution or expansion of the principle contained in the familiar cast-iron fronts, and in the oft-used method of increasing the bearing strength of a brick pier of too small an area safely to bear alone the load to be imposed, by placing an iron column in the center of the pier.

Obviously it is to the interest of an owner, as well as necessary for public safety, that an excessively high building shall be so constructed that in the event of fire the building itself shall not be seriously damaged, nor shall it imperil the safety of surrounding buildings. Laws regulating the construction of buildings in New York require all structures above a stated height (eighty-five feet) to be built fire-proof; that is to say, they must be constructed with walls of brick, stone, or iron, the floors and roofs of materials similar to the walls, and the stairs also must be of incombustible materials. Fire-proof floors are now commonly constructed of rolled iron or steel I-beams, with arches of burnt clay between the beams.

The first wrought-iron I-beams rolled in this country were made by Peter Cooper, at his mills in Trenton, N. J., about 1860. The Phœnix Iron Company, of Pennsylvania, began to roll them about the same time. Prior to that date there was a very limited number of fire-proof buildings in this country. Those which did exist chiefly belonged to the government. In the early fire-proof structures erected in New York City—the Cooper Union building, Harper's publishing building, and the Historical Library building—the iron floor-beams are of a shape known as deck-beams, being very similar in section to an ordinary rail, only deeper. The depths of I-beams have been increased from six and seven inches up to twenty-four inches, and mild steel has displaced wrought-iron. Eastern and Western rolling-mills yearly turn out an enormous quantity of rolled steel I-beams for use in buildings.

Before the time when rolled beams could be expeditiously procured and at moderate prices, cast-iron beams were used. When the openings to be spanned were of considerable width, bowstring-girders, or arch-shaped castings with horizontal wrought-iron tie-rods connecting the ends, were commonly used. It is admitted by all who are competent to judge that wrought-iron or steel is superior for use where the load tends to tear the metal asunder; and in course of time cast-iron for beams and girders became almost entirely superseded by rolled wrought-iron, and later on by rolled steel. The use of cast-iron beams, lintels, and columns in commercial buildings kept a number of large foundries in New York busy for many years. More than half a century ago the Jackson Architectural Iron-Works, now a corporation, were started, being practically the pioneer foundry for the manufacture of ironwork for buildings. It was in these works that the first entire iron front was made, from drawings furnished by the introducer, James Bogardus. Several firms that became quite renowned in the line of architectural ironwork—among them J. B. & W. W. Cornell—procured their cast-iron work for many years from the Jackson foundry. Iron fronts became popular, and New York supplied the demand from Boston, Philadelphia, Chicago, and St. Louis, until finally their manufacture was taken up in every section of the country. During the past ten years architects have shown a preference for fronts of brick with terra-cotta or stone for trimmings, and cast-iron fronts have largely gone out of fashion, perhaps later on to be revived, particularly for commercial structures, as cast-iron has in its favor unequaled advantages of lightness, strength, durability, economy, incombustibility, and ready renovation. John Roach, who became celebrated as an iron-ship builder, started in the foundry business in a small way in New York about the year 1840, making castings for builders' uses; but he veered off into ships' castings and machinery, and finally into building ships.

The Jackson foundry was started to manufacture grates and fenders, and during all the years of its existence has continued that as one of its principal branches. It was the establishment of a new industry in this country, for these things were all imported from abroad. While fireplace fronts can scarcely be included among "building materials," in the ordinary understanding of that term, yet they go to make up a permanent and necessary part of buildings. There are a number of other adjuncts to an edifice that cannot properly be included as building materials, but each of which makes progressive steps in providing useful, convenient, and comfortable structures. In a modern building electric light and steam-heat are looked for as matters of course; and mail-chutes, telephone and electric call service are developments of recent years. In dwelling-houses gas-stoves are supplanting coal-ranges for cooking; the old-fashioned pan water-closet has given way to the S trap-bowl; bath-tubs are of enameled iron, solid porcelain, or marble, instead of wood lined with copper or other metal; pneumatic or electric appliances open the street-door at will; locks that are unpickable and burglar-alarms secure reasonable

William H. Jackson.

safety from would-be intruders; and in a variety of ways the conveniences, comforts, security, and healthfulness of homes have been added to of late years by provisions made in the planning and construction of buildings.

Formerly French or English plate-glass was demanded for every good building. American plate-glass slowly but surely worked to the front rank in quality, and has become one of our great home industries. In art glass-work for windows, American manufacturers and American artists produce the equal of the best made in any other country, but the time was not long ago when everything in that line of art-work was of foreign make.

Marbles in great variety, sandstones in almost every color, and granite of various hues are quarried in all directions; and through cheap transportation by water or rail, every section of the country has an available supply of every kind and color of stone for architectural effect in buildings. Stone is planed and carved by machinery more accurately and quicker than by hand. The labor thus saved, and the consequent cheapening of molded and carved stone, have increased the consumption and given employment to a far greater number of workmen than would otherwise have been the case. The world's experience has shown, moreover, that while machinery increases production, it also opens new fields for useful labor, and the cheapening of the cost of manufactured products proportionately increases their consumption by bringing them within the reach of a greater number of persons. Not only in stone, but in every kind of material which enters into the construction and finishing of buildings, has machinery reduced the cost. The army of workmen is vastly greater in numbers, and wages are higher, than when hand labor had the field entirely to itself.

Wood moldings were laboriously worked out by hand in former years. Machinery changed all that, so that to-day a carpenter would as soon think of hewing out timber from the log by hand as to work out by hand the trim for a house. From the molding-mill the trim now comes all ready to be put in place. Hard woods, especially ash and oak, have largely taken the place of white pine for trim, and it is due to machinery that doors and architraves around openings can be obtained in hard woods at less cost than the same in soft woods could have been had a few years ago. Hard wood for mantels, of all grades from the simple and cheap to the elaborate and costly, has, to a great extent, taken the place of marble and slate. The advance in woodworking machinery and in carving by machinery enables very artistic and elaborate work in wood to be obtained at very reasonable prices, and architects and builders have not been slow in availing themselves of their opportunities. Improved fillers and varnish coatings for hard woods are on sale in every paint-store, and cabinet finish is easily and cheaply produced. Ready-mixed paints for interior and exterior uses are extensively used, the grinding being done by machinery, the mixing, therefore, being more thorough than by hand. Paint mixed with such ingredients that fire is repelled from wood or other materials coated with it is a comparatively new article of manufacture, but is being largely used for protecting frame factories and other buildings where the danger of burning is great. Wire cloth, in place of wood lath, is much used, not only because it keeps the plaster better and prevents cracks, but because it makes a good fire-resisting surface for ceilings under wood beams and on the sides of wood studs. A variety of solid, thin, light, and strong partitions of iron and plaster are used in place of the wood-stud, lath, and plaster partitions, so dangerous in case of fire. Mortar and plaster mixed by machinery are supplied to masons in any quantity required. The mixing being more perfectly done by machinery than by the hoe, the blisters so often seen on finished wall surfaces, due to bad mixing, are obviated. To ordinary plaster other ingredients are now added, these plaster mixtures being known in the market under several different names, but all having for their object hardness and durability. A few years ago American hydraulic cements were looked upon with extreme suspicion by engineers and architects, and imported Portland cements were demanded for use in important foundation-work. Now American cements are recognized as having equal strength with the English and German cements, joined with other good qualities, and are sold at lower prices than the imported brands.

In appearance the streets in our great cities are taking on a lighter hue, due to the light-colored brick so generally used for the fronts of new buildings. Twenty-five years ago, in New York, red was the universal color for front brick, the choice front brick being brought from Philadelphia and Baltimore. The clays of New Jersey give us brick in white, lemon, buff, mottled, and other hues, and these are used to the exclusion of red. Terra-cotta in a variety of colors and artistically executed enters largely into the ornamental treatment of the fronts of buildings. The extensive use of this material,

and the erection of manufactories for its production, are of recent date in this country. In clay products alone architects have a chance to display taste and skill of which their professional brethren a decade or so ago never entertained a thought.

In the Post-Office building in this city, a little more than twenty years ago, hollow-tile flat arches between iron floor-beams were introduced for the first time in this or any other country. This was the invention of Mr. B. Kreischer, a manufacturer of fire-brick in New York. The flat-arch system provided a level ceiling at once, at a less cost and with much less weight of material than filling in between iron beams with segmental arches of common brick, and then furring down with wood or iron to obtain a level ceiling surface. The new system came into general use for fire-proof buildings all over the United States. A long litigation ensued over the patent, but under the crucial test of publications from all parts of the globe, the courts finally decided the Kreischer patent void for want of originality. Abroad the system of flat arches whose end sections abut against rolled iron or steel beams for floorings is recognized as an American invention, and at a meeting of the Royal Institute of British Architects, held in 1882, this method of constructing floors was commented upon, the chairman of that meeting going on to say that when a man in the United States brought out a good invention connected with building or anything else, it was straightway adopted all over the country, remaining in use until something better was provided, when that, in its turn, was taken up.

Another American invention whose merit has been recognized everywhere is illuminated tiles —the placing of small disks of glass in iron plates which form a walking surface and at the same time transmit light to a vault or room beneath the sidewalk. The name Hyatt will always be associated with this invention in America and Europe. Years of litigation ensued after the introduction and use of this invention, but fortunately for the inventor the court decisions were finally in his favor, by which he realized large sums of money.

Iron for the frame and bars of skylights has superseded wood in all large cities, in part because modern building laws will not permit the use of wood for any but very small skylights. Twenty-five years ago iron skylight bars were of solid rolled iron. An American inventor, Hayes, introduced skylight bars of sheet-iron, bent by machinery to a proper shape, and these light, strong, and cheap bars are now everywhere in use. Galvanized sheet-iron for cornices on the fronts of buildings has taken the place of wood in cities, and in the manufacture of them an enormous amount of sheet-metal is used annually.

In bank and safe-deposit buildings the burglar-proof work for vaults and strong rooms represents a very large manufacturing industry in providing what is deemed essential to the equipment of such structures. Bank vaults of chilled iron and steel were used a long time ago, but the increase in the demand for burglar-proof work resulted in improved methods of construction, and in the invention of better time-locks and alarm appliances to give warning of attempts at burglary.

Wood necessarily enters into the construction of buildings of every character. Hundreds of millions of dollars are invested in the work of handling this material, and several hundred thousand artisans are employed in preparing it for use from the time the logs are gathered in the forests until they are fashioned into the required shapes. This industry is among the most important in the United States, but there are no reliable data extant from which anything approaching an accurate estimate of the capital invested or the number of timber workers employed can be determined. Some idea of its magnitude may be formed when it has been estimated by builders of wide experience that out of some 12,000,000 dwelling-houses in the United States nearly 11,000,000 are built mainly of wood.

In the almost countless number of fire-proof buildings the stairs, of course, are made of incombustible materials—iron for the strings, risers, and railings, and slate or marble for the treads. Several large iron-works devote their attention solely to this class of manufacture. The variety of designs and the coating of the iron with other metals by electro-processes, or by a process that preserves iron against rust without paint, go to make up in extent and beauty a branch of iron manufacture that has developed from very small beginnings to extensive proportions. The inclosure of elevator-shafts in fire-proof buildings is generally of iron grille-work, which has the same characteristics as iron stair-work in points of design and workmanship.

In putting the different kinds of materials in place in the building a saving of time and labor is sought. Even in ordinary buildings brick and mortar are no longer carried on men's backs up a ladder. Hod-hoisting machinery has taken the place of manual labor in this respect. On important buildings power-derricks lift all heavy weights from the ground to the uppermost story—stone, iron, and

everything else. It is not an unusual sight to see a cart-load of brick brought to a building, the horse then unhitched, the cart hoisted by the derrick to an upper story, and the brick dumped, after which the cart is lowered to the ground. The riveting of connecting parts of ironwork in important buildings is frequently done by machine instead of by hand. Foundations for high buildings, where the soil is uncertain or inadequate to bear enormous loads, are in some instances carried down to rock by means of cylinders of iron sunk to the required depth and then filled in with masonry. In other cases a framing of iron beams covering the whole area of the building, much like a raft, is laid and covered with concrete. Engineering skill in its application to building work has no limit, in reality; it can reach down deep into the ground or tower up high toward the clouds. But the opportunities to do the things that would have been considered marvelous a century ago have arisen only during late years. Possibly the same ability existed then, but the call for its exercise has come with a more recent date.

Architecture has played a most important part in the development of the modern building. Consequently a slight departure from the main thread of this subject may be allowable in order better to trace the progress of the century in the building line. The origin of architecture is wrapped in obscurity. Caves and huts of branches were the first buildings made by man. Examples of a second stage of development are found in the stone monuments of various islands in the Pacific and in the ancient monuments of America. The ruins of Mexico show no foreign influence in their artistic workmanship, and are therefore regarded as an independent national development. Some of these show an advanced and highly ornamented form of the pyramid. Of Oriental architecture the Egyptian examples are perhaps the most striking. The numerous monuments of India can be compared in extent and magnificence only with those of Egypt. China received its architecture from India. Grecian, Roman, and Gothic architecture furnishes high examples of the art, and many of its features are interwoven with modern architecture.

A new period in the development of architecture began about the close of the eighteenth century, when a reaction against the rococo style made itself felt. Important examples are the Mint in Berlin and the Brandenburg Gate, built at the close of the eighteenth century. The age and conditions of American civilization do not admit of an indigenous architectural development, as in older countries, and therefore we find in the United States examples of almost every known national style. The building operations of the settlers of the seventeenth century were modeled upon those of the countries whence they had emigrated.

Thus the early buildings of New England and Virginia are essentially English; those of New York and Pennsylvania are Dutch and German; while Florida shows thoroughly Spanish architecture, and New Orleans is practically a transplanted French city. With the beginning of the eighteenth century the increased intercourse between the individual colonies gave rise to a more homogeneous architecture. The more important buildings of the period are all the works of English architects, among them being King's Chapel, Boston (1749), by Harrison, and St. Michael's, Charleston, S. C. (1752), by Gibson, a pupil of Wren. To the same period belong Christ Church, Philadelphia, and the old State-houses of Boston and Philadelphia. The dwelling-houses of the colonial period were simple in style and usually of wood, depending for their external effect principally upon the use of columns, and with interiors of great plainness, the ornamentation being concentrated in the staircases, of which some artistic examples are still in existence.

The first and chief of the government buildings at Washington was the Capitol. In its present form the Capitol is a monumental edifice with a dome 135 feet in diameter rising 217 feet above the roof. The architectural effect is secured by the free use of porticos and colonnades, and by the striking approaches. The other government buildings are of a similar style. Since that period a style founded on the Italian Renaissance has been employed in nearly all public buildings, sometimes with great success. To this period, also, belongs the New York City Hall (1803–12), built of marble and freestone, which at the time of its erection surpassed all buildings here in material and conception. For a time Greek architecture became the fashion, and it was applied to many buildings. To this development belong the Custom-houses in Philadelphia and New York (with monolithic columns) and Boston, and Girard College, Philadelphia.

The first successful attempt of Gothic architecture was the erection, in 1839–45, in New York, of Trinity Church, by Richard Upjohn, which has since remained the accepted type of American church buildings. From the church the Gothic style was for a time carried to all other classes of buildings, but was soon abandoned. With the rapid growth of the country in wealth and ambition there

succeeded crazes for various architectural styles. Egyptian, Moorish, Swiss, and other types were employed, but finally all of them were abandoned. Subsequently a revival of Gothic architecture, under the influence of Ruskin, produced some buildings of merit, among them the National Academy of Design, New York, largely in the Venetian style; the State Capitol of Connecticut, at Hartford; and the Harvard Alumni Memorial Hall, at Cambridge.

During recent years the prevailing style for municipal buildings has been that of the French Renaissance. Imposing examples of this style are seen in the new municipal buildings of Philadelphia and in the new buildings of the State and War departments at Washington. Many of the newer capitol buildings of the various States are of architectural merit, the most elaborate being the Capitol at Albany. In church architecture, New York, Boston, Chicago, Baltimore, Philadelphia, and some Western cities possess good examples of Gothic and other styles. The largest and most costly church edifice on the continent is St. Patrick's Cathedral, in New York. A notable departure from the Gothic style is seen in Trinity Church, Boston, where the Romanesque has been employed with great artistic success.

Much of the sameness and monotony in dwelling-houses which obtains in most of the older cities is giving way to a pleasing variety, especially in newer localities. This change is largely due to the formation of schools of architecture, which are turning out thoroughly equipped native architects. The American Institute of Architects, founded in 1867, with its local branches, assists in encouraging professional intercourse among its members, and the various architectural journals spread an increasing knowledge of the art. All these agencies combine to form a national educated taste which may originate a national type of architecture, thus rendering impossible the crudities of past generations, and developing refinement in the choice or combination of existing styles.

Every one of the group of subjects referred to occupies a relationship more or less intimate to the others. A modern building is something more than merely the walls and roof. It includes the products of trades that a century ago had no existence, others that have lived less than half a century, and still others that less than a quarter of a century ago were unknown. With the growth of population the number of buildings proportionately increases. In our great cities many families living independently of one another occupy together a single building, while the former rule was one family to a house. New conditions of living have arisen, not merely for the poor in tenement-houses, but for the well-to-do and affluent, in the aggregation of many homes under one roof. Increasing the size of buildings vertically instead of horizontally called for the working out of new problems not only in engineering, but in sanitary science. American ingenuity and skill have, however, kept pace with every requirement or necessity. The achievements and progress in every direction which have added so much to the welfare and greatness of our country during the past one hundred years have nowhere been more marked than in the materials used and the knowledge of their proper applications in the construction of buildings.

William H. Jackson

CHAPTER LIV

ELECTRICAL MANUFACTURING INTERESTS

THERE is no way in which the electrical industries of 1895 can be compared with those of 1795, for the simple reason that a hundred years ago electrical science was rudimentary and the electrical arts were all unborn. A few stray pieces of apparatus built by instrument makers under the vague directions of philosophical investigators constituted throughout the first quarter of the present century the bases from which all our later inventions and developments have dated. It was not until within the last fifty years that, the correlation of electricity and magnetism being fairly understood, and the ability to turn mechanical energy into current being fully perceived, the world enjoyed the benefits, in quick succession, of telegraphy, electroplating, electric lighting, telephony, electric power, electric traction, electric heating, forging, welding, and cooling, and the electric extraction of minerals and precious metals. These constitute a noteworthy fruition for five decades, yet have barely scratched the possibilities, and have so far been limited in their usefulness almost entirely to urban populations. Strange as it may seem at a time when dwellers in the city encounter electrical appliances on every side, there is not a single art that has been a direct boon to the agricultural sections of the country, despite the fact that America is a land of farms, and that here electricity has been more vigorously exploited, and in more ways, than anywhere else in the world. Electricity is, in fact, at the present moment, curiously associated with the intense and crowded city life that engages the thoughts of social and political economists; but indications are not wanting that it is the agency chiefly to be relied upon hereafter in the closer knitting together of city and country, the increasing of facilities for commerce, and the diffusion throughout remote districts of information that should be common to all.

The telegraph, representing a pioneer electrical development, has attained, it is believed by many, the magnitude of maturity, while its methods are pretty much the same as when Morse first operated his crude devices. Inclusive of allied and similar services to the public, the telegraph system of the United States reaches a capitalization of about $200,000,000, of which the Western Union and Postal lines may be credited with more than one half. The condition of the telegraph industry is portrayed in the following figures:

MESSAGES SENT BY THE WESTERN UNION TELEGRAPH COMPANY.

Year.	Messages.	Receipts.	Expenses.	Average Toll per Message.	Average Cost per Message.
1892	62,387,298	$23,706,404	$16,307,857	31.6	22.3
1893	66,591,858	24,978,442	17,482,405	31.2	22.7
1894	58,632,237	21,852,655	16,060,170	30.5	23.3
1895	58,307,315	22,218,019	16,076,630	30.7	23.3

Hence it will appear that there is no rapid expansion in telegraphy going on, nor can there be one without some very radical changes. If the population of the United States of America be taken at 65,000,000, it would appear that only one telegram per head per year is sent, and the ratio remains about the same through many years, without any variation that denotes a growing habit on the part of the people.

When we turn to telephony an explanation of this state of affairs is seen. The advent of Professor Bell's telephone in 1876 found capital quite averse to assuming any risk in it, and even in 1879 the Western Union Telegraph Company surrendered all its telephonic work to the American Bell Telephone

Company, on condition of being paid for a term of years twenty per cent. commission on the receipts in royalties from the telephone—an arrangement which has brought some $7,000,000 into the Western Union treasury without any expenditure. But the telephone has meantime gained ground so enormously that some observers believe the effectual supercession of the older telegraph to be well in sight. The American people now exchange yearly 750,000,000 telephonic talks; that is, they use the telephone ten times as much as they do the telegraph, at infinitely less cost. Each telephone talk through an exchange costs the subscriber less than five cents on the average. Every twenty-four hours the telephone is used more than 2,000,000 times, so that, broadly, 4,000,000 people, or twenty-five per cent. of the adult population, resort to it daily, chiefly for commercial purposes. As an actual fact, hand-written letters are only four times as numerous; and thus, if both telegraph and telephone were out of existence, the number of sealed pieces of mail matter, on the same calculation, would be increased by 800,000,000. New York City alone would require 40,000 district messenger-boys to carry around its communications that are now sent in a single day over its telephone wires.

The total investment in telephony, however, in 1894, was only $77,500,000, although it is rapidly increasing. One of the most important commercial branches of it is the long-distance work, which, begun in 1885, is done with a ramification of 55,000 miles of pole-line and 265,000 miles of wire, connecting together no fewer than 2000 towns and cities by double or "metallic" circuit, any one of which places any telephone subscriber in New York, for example, can reach; while the public can do the same in this city by using some 1200 scattered pay stations. The rate to Chicago from New York is $9 for five minutes' talk, or $4.50 at night. The recent expiration of fundamental patents has also greatly stimulated telephonic work.

In view of these and other conditions, Mr. P. B. Delany, a well-known electrician, has worked out a plan that would render the telegraph remarkably valuable, and popularly rehabilitate it. He proposes that letters shall be telegraphed instead of carried by trains. There are 40,000 letters exchanged daily, for instance, between New York and Chicago, and the perfection of methods now is such in "machine telegraphy" that with two good copper wires he would carry 28,000 messages of fifty words each daily between the two cities. The contrast with old methods is seen in the statement that with a single copper wire of only 300 pounds to the mile, thus machine-worked between New York and Philadelphia, Mr. Delany proposes to handle 3000 words per minute; whereas by the present key system in vogue, for the same quantity of matter, thirty-eight wires must be worked quadruplex, or 152 circuits, at about twenty words per minute. Here certainly lies a great future, with great benefit, if the plan is feasible, to commercial and social intercourse.

Although this country ranks with England in its patronage of the submarine cable, and is proud of the indomitable New York merchant, Cyrus Field, it has no cable industry and a very small cable ownership. Vast as are the quantities of fine cable made in America for telegraphic and telephonic work along its rivers and lakes, the American cable is still unknown to the deep seas. There has been no period, apparently, since the New World was electrically moored alongside the Old, when our manufacturers could, in this branch, compete on equal terms with those of England and Germany.

The fire-alarm telegraphs have been an important item in this field of manufacture, and there are over 600 places equipped, generally with the Gamewell system, which is, perhaps, the best known. In 1890, the last year for which definite statistics are available, a group of fifty cities had no fewer than 8400 fire-alarm boxes in use by their fire departments. A system for a small city costs about $1000. Every city has now its police telegraph also, many combining with it a telephonic patrol system that brings a squad to any point within five minutes after the call is sent in. The district messenger system has become familiar in most American cities, as an auxiliary to the telegraph. In New York City the average number of boys employed for this work is 1200, who run some 2,500,000 errands in a year. That the boys loiter is obviously a calumny.

As an offset, perhaps, to the European preëminence in the one department of submarine telegraphy, we may turn to the generous figures of the growth of electric lighting in the United States. There are barely one hundred central stations in all Great Britain; there are 2500 local electric-light companies here, and some 200 municipal plants. The investment there has reached $35,000,000; in such work in this country the total is placed at $300,000,000, New York alone approximating the figures for all England. Of isolated plants for arc or incandescent lighting in mills, mines, stores, halls, docks, etc., the number in the United States has reached probably 7500; there were in 1893 no fewer than 3500 such isolated incandescent plants, with

a capacity of 1,500,000 lamps. The value of the total arc and incandescent outlay, independent entirely of the central stations, is placed at $200,000,000. All this is the outcome of the inventions of men like Edison, Brush, Elihu Thomson, Weston, Wood, Hochhausen, and, in the new era just beginning, Nikola Tesla, Stanley, Bradley, and Steinmetz. At one time some forty or fifty manufacturing companies competed for the sale of the plant; but the art has in many respects become specialized, and the leading survivors are the General Electric, Westinghouse, Fort Wayne, Excelsior, Brush, Standard, and Western Electric companies. The General Electric Company, for example, had its arc apparatus operating in 957 central stations, in May, 1895, supplying 130,000 arc-lights. This is a typical "parent" company, which now has a total capital of about $44,000,000, employs some 7000 men in its factories, and has an annual output ranging from $10,000,000 to $15,000,000. A typical "local" suborganization is the Chicago Edison Company, with a capital of $7,000,000, and four central stations supplying current daily for 161,000 incandescent lamps, 4000 horse-power of electric motors, and 3600 arc-lamps, using about 500 miles of underground tubing and cable to reach its customers. A typical isolated plant is that in the Auditorium, Chicago, with 17,000 incandescent lamps; or that in the new Carnegie Steel-Works, at Duquesne, Pa., where 3000 horse-power is used for electric light and power.

The practical incandescent lamp was brought to commercial perfection by Edison less than twenty years ago. The dynamo capacity in this country to-day for incandescent lighting is estimated at over 8,000,000 lamps of sixteen candle-power, while the number connected to the circuits is from 12,000,000 to 15,000,000. The number of lamps produced by about a score of factories is from 50,000 to 75,000 daily. Ten years ago an incandescent lamp cost the consumer not much less than one dollar, while excellent lamps are now bought at about twenty cents apiece. The average life of lamps is 600 to 800 hours. Equally remarkable is the reduction in the cost of carbon-points for arc-lamps. In 1876 they were imported from a French maker, a dozen or two in the batch, at forty cents each. The American manufacture began in 1878, with over thirty hand processes, and at prices of $80 per 1000. The carbon art to-day recognizes only four hand processes, and prices are in the neighborhood of $10 per 1000. Within the past fifteen years some seventy-five factories have been started to supply the annual consumption of 200,000,000 carbon-points, and their capacity has reached three times that figure. There are to-day twenty-five factories in the world, with a capacity of, say, 350,000,000 per annum. The largest of these factories is in Cleveland, O., owned by the National Carbon Company, comprising fourteen large buildings on seventeen acres of ground, with a capacity of 250,000,000 per annum.

All these seem large figures, but as a matter of calculation it will be found that they would need a tenfold multiplication if electric light were entirely to replace gas. The process is, however, going on, with the effect at the same time of raising the standard of illumination everywhere, and greatly cheapening gas production. In 1890 no fewer than 278 American cities, with a population of 7,000,000, had entirely given up gas for electricity in lighting their streets. Although no municipal gas-plants are now erected, the number of electric-lighting plants built by municipalities is strikingly on the increase all over the Union.

Associated closely with electric light is electric power, the motors being placed on the same circuits as the lamps. All the concerns building electric-light apparatus also build motors; but there are about a dozen factories, such as the Crocker-Wheeler, and Eddy, that devote themselves exclusively to motors, of which it is estimated that 500,000 are now in use, the bulk of these being the small fan-motors for ventilation, costing, on an average, $15 each. Motors of fifty horse-power and upward are, however, by no means uncommon; while the tendency in all new factories, machine-shops, etc., is to distribute power by such motors, instead of using long lines of belt and shafting. At the Homestead, Pa., Steel-Works, for example, power is thus furnished to electric motors aggregating 4000 horse-power; at Bessemer, Pa., to about 2000 horse-power; and a third metal plant has thirty electric cranes, three electric traveling bridges, six motor freight conveyers, fifteen motor-cars, and a score of motors for miscellaneous purposes.

The use of electric elevators in cities, furnished with current from both central stations and isolated plants, is a distinct class of work. In New York there are several hundred of these elevators, requiring a total of upward of 5000 horse-power daily for their operation. For the Parrott Building in San Francisco Mr. F. J. Sprague is furnishing fifteen of his electric elevators. At present to be found chiefly in office buildings, they have already made their way into apartments and into private dwellings. Electric heating and cooking apparatus, fed with

current from central stations, is also becoming familiar, especially in laundries, restaurants, canneries, and hair-dressing establishments.

A few years ago the dynamos in central stations were large that would operate 500 lamps; to-day machines of from 5000 to 25,000 lamp capacity are not unusual. These are now driven directly by huge steam-engines of the vertical triple-expansion marine type. In the same manner arc-dynamos were usually able to energize twenty-five or thirty arcs of 2000 candle-power each; but their place is being taken by machines that will feed 150 to 200 such lamps on circuits thirty and forty miles long. It is evident that great economy is thus effected. Arc-lighting, which at its introduction cost seventy-five cents or more per night per lamp, now averages from thirty to thirty-five cents. Incandescent lamps cost about one cent an hour each for current, and motors obtain their supply at less than ten cents per horse-power per hour. Whereas it was once the well-nigh universal custom to sell a current at a "flat rate," it is now the more scientific custom to meter it. Indeed, one of the most significant developments of late years has been the perfection of American electrical instruments of measurement and precision devised for lighting and power circuits. Those of Edward Weston have won a reputation that has gone around the world.

Very early indeed were the efforts made in electric railroading. The work of Thomas Davenport, a Vermont blacksmith, fifty odd years ago, embodied many of the elements familiar in the street-railway of to-day; but no progress was made, because the primary battery was then the sole source of current. It was not until within the last ten years that the electric railway industry became established. The present writer collected the first American statistics on the subject in 1887. There were then but thirteen small roads. This year the trolley roads in the United States have reached the imposing total of 900, with 11,000 miles of track, 25,000 cars, and a capitalization of fully $750,000,000, which in spite of frequent inflation has a notable dividend-earning capacity, rarely falling below six per cent. for the bonds, and the common stock receiving as much. The ability of electricity to increase the traffic of a street-railway has hardly ever been less than forty per cent. in the year of its adoption, and has frequently exceeded one hundred per cent. In all Europe the number of electric roads is below 100. The annual increase here is at least that number, representing a purchase of some $100,000,000 worth of rails, cars, motors, wire, engines, boilers, poles, etc.

The electric railway industry has endless aspects. In New York, Washington, and Chicago, underground trolley conduit roads are being adopted instead of the overhead trolley type, with fair success. In Chicago, at the World's Fair, an elevated electric road carried 8,000,000 passengers, and there is now a similar road in regular operation in that city. For New York City is proposed a tunnel electric railway system, to cost the metropolitan taxpayers $50,000,000, on the plan so successful for some years past in London.

Nor is this all. As far back as the summer of 1894 there were sixty-two street-car lines carrying United States mail; thirty-five lines had gone into the express business, and fifty-five were hauling freight. These figures have probably been doubled in the past twelvemonth. More interesting still is the interurban extension of the trolley system. Within a year as many as 190 electric railway companies have been projected to ply across country, with 3457 miles of track. Many of these have been built and are already running. They range from four miles up to seventy-five in length. The competition of these roads and the regular street trolley railways with steam railroads has begun to revolutionize the latter, if only for the reason that ten miles for five cents is an ordinary car trip, while the steam train needs ten cents for five miles for its maintenance. On some steam roads the suburban travel has been practically wiped out, and a great many schedules have been abandoned. To meet this serious condition of affairs the Pennsylvania, and the New York, New Haven, and Hartford Railroads, as well as others less well known, have adopted electricity for some of their branches with marked success; and the intention is to carry this change much further at once.

Additional to this is the use of heavy 1500 horse-power electric locomotives by the Baltimore and Ohio Railroad Company for freight haulage in its Baltimore tunnel. These locomotives haul trains of 1400 tons, and make, when necessary, a speed of sixty miles an hour. The same method is to be adopted for the Grand Trunk Tunnel under the St. Clair River. In short, the steam railroad system is at the point of a new departure, and is everywhere being prepared for the greater utilization of electricity.

An art allied to electric locomotion is that of electric navigation. At the World's Fair in Chicago in 1893, 1,003,500 passengers were carried on the lagoons by a fleet of fifty electric launches; and these boats, scattered all over the country, have become nuclei for a number of smaller busy fleets

T. Commerford Martin.

employed by trolley railways, park boards, police departments, and private owners. These boats are operated by means of storage batteries charged from time to time, and able to run them continuously for forty or fifty miles. A boat of such a character, making ten to twelve miles an hour, thirty-five feet in length and six to eight feet beam, is obtainable complete for about $1600.

The storage battery has been far more successful afloat than in street-car propulsion, but it is now in swift adoption for isolated plants and central stations, as a reservoir of current when the machinery is not in operation. The Edison Company in Boston has recently erected and equipped a five-story building as a storage-battery adjunct, which supplements an earlier annex of the same kind, the two together being by far the largest in the world. They have a capacity of 30,000 amperes of current, or 60,000 lamps; and have taken care of all demands on the company for current during periods of fifteen hours. It is becoming the practice, also, to equip fire-alarm departments with storage batteries in place of the old primary batteries.

Electric mining is one of the latest of the industries to be developed by the electrical engineer, and bids fair to surpass the electric railway in magnitude. The demand for apparatus in it is estimated to have reached already the sum of $100,000,000, for hoists, crushers, drills, pumps, ventilators, cars, etc., all driven electrically. The adoption of this machinery, furnished with current from dynamos driven by water-power, has enabled scores of mines to pay expenses that were unable to do so with fuel as high as $15 a ton. Some of these plants are being operated at altitudes of 12,000 feet above sea-level, and exemplify the beauties of long-distance electrical power transmission, which in itself is even now constituting a separate field of endeavor.

By all odds the most important long-distance electrical power enterprise is that of the Niagara Falls Power Company, in the utilization of part of the energy of the great cataract. By means of its plants on both sides of the Niagara River this company will develop 350,000 horse-power; and its power-house, canal, and tunnel on the American side are adequate to the production of 100,000 horse-power of electrical current, generated by the Tesla two-phase system. An expenditure of $3,000,000 has been made, and is now yielding an income. Part of the current is being used in the electrical manufacture at the falls of aluminium and carborundum, and a large manufacturing city is beginning to form about a mile above the falls, free from smoke, dust, and gases, all the energy being distributed silently over hidden wires. Arrangements have been made by which Buffalo, twenty-two miles away, is to receive this current in large quantities, the price being $18 per horse-power at the Niagara end of the line; while it is estimated by experts that the current can even be delivered 300 miles away in Albany, to compete on equal terms with the power of steam-engines on the spot, using coal at $3 per ton. The boats on the Erie Canal are also to have this power, at a rate of $20 per horse-power per year, and vital improvement in canal haulage is expected. The first trials in this direction have been made, with notable success. All over the United States the example at Niagara is being imitated, and millions of dollars are pledged for similar water-power utilizations, while a great many such plants have gone into commercial operation.

Incidental reference has been made to the use of American electrical measuring instruments abroad. But for the fact that our own markets have had so large a capacity of consumption, an enormous export trade would long ago have grown up. As it is, the demand from foreign countries in certain lines is already respectable. Throughout Mexico, the West Indies, Central America, and South America, our dynamos for light, and motors for power, are in use on an extensive scale; and many are also found in Canada, although it is the practice there to manufacture under patents of American electrical inventors. A considerable part of the new gold-mining work in South Africa is done with American electrical plant; and Buluwayo, which but two years ago was the bush capital of savage Lobengula, is lit every night from a central station whose machinery was made in New York State. Japan and China have taken large quantities of electric-lighting apparatus from us; the royal palace of Corea is illuminated by our incandescent lamps; American telephones are thickly strung in the Sandwich Islands; and electric railway plants from Ohio are in successful operation in Indo-China. Even England has not disdained to take electric motors and electric railway apparatus from us, and some of her most important electrical manufacturing corporations bear famous American names and employ many American inventions and methods. Indeed, if the remark of Emerson be true, that steam is half an Englishman, we may with equal felicity assert that electricity is nine tenths an American.

The above are to-day the main lines of American electrical manufacturing and supply, reaching toward a capital of $1,500,000,000; but they are

not all, and they draw their material from a swarm of subsidiary industries; while they throw out every year new commercial tendrils and employ thousands of intermediaries in order to gain access to the public. The electric refining of metals is a growing department, in which millions are invested annually. There are 392 electroplating establishments in the United States, with a capital of $38,000,000, employing 2700 hands; and there are also no fewer than 300 electrotyping firms, besides large numbers of etching and jewelry houses using current in their work. The insulated wire and cable factories number a dozen. Their output mounts into countless millions of feet of wire annually, while the practice of running interior wires through tubes has necessitated the production of some 15,000,000 feet of insulated conduit annually. Merely placing wires underground is estimated to have required $150,000,000 for cables and subways. Every hotel in the country has its annunciator system, and every private residence of any pretension has at least its electric bells. In medicine, electrotherapy is so well recognized that a score of large manufacturers are busy turning out galvanic and faradic apparatus for practitioners of all schools. The production of disinfectants electrically has assumed large proportions, and their use is growing. The place of electricity in education may be gauged by the fact that 1500 students take up electrical engineering in a single year as a special study at leading colleges. It is seen clearly to-day that the future of all the electrical arts depends upon a reduction in the cost of current, and to this end Mr. Tesla has devised his oscillator, combining steam-engine and dynamo in an integral mechanism which shall create and distribute power at half or one quarter the present cost. Others are working at the problem of obtaining electricity directly from heat; and if there be one thing that is clearly written upon the face of mechanical and industrial advance, it is that the succeeding century, no less than the present has been that of steam, will be emphatically the age of electricity.

T. C. Martin

CHAPTER LV

THE PACKING INDUSTRY

THE packing industry may be considered as applying more particularly to the curing and packing of hog products; but no review of this business would be complete which did not take into consideration the slaughtering, dressing, and shipping of cattle and sheep. The American packing-house of to-day is usually found combining the two branches of business, although it is true that only a small percentage of the product from the cattle and sheep is "packed," using the term in its most literal sense.

The information available does not make it plain as to where and when the packing industry, as distinct from butchering operations and incidental curing of meats, had its origin. It is said—although I cannot find satisfactory proof of the statement—that pork was cured and packed in barrels in Salem, Mass., in 1640, and it is certain that, about 1690, Boston did quite a trade in that line; but the paternity of the Western packing business, as we understand it to-day, belongs, I think, to Cincinnati. In 1818, one Elisha Mills, a "down-easter," was established as a packer in Cincinnati. The first drove of hogs ever received in Chicago was in 1827, but no attempt at packing seems to have been made until 1832. In that year George W. Dole packed some pork for Oliver Newbury, of Detroit; but Chicago does not figure in the statistics of packing points until 1850. It is claimed that 9600 hogs were packed there in 1834. It was not until the season of 1832–33 that a definite attempt was made to obtain statistics covering such operations. In that winter Cincinnati was credited with slaughtering 85,000 hogs, several houses being engaged in the business.

The development of the agricultural resources of the Western States, especially from Ohio to the Mississippi and Missouri rivers, cheapened the cost of producing animals, particularly hogs; and attention to their production was stimulated and encouraged by the demands from Southern and Eastern dealers for product for their markets. Packing operations naturally followed in many places west of Cincinnati, more or less directly in communication with the transportation facilities afforded by river navigation. The movement of the product was by way of the Ohio and Mississippi rivers to New Orleans, and a great deal was shipped thence by vessels to Baltimore, Philadelphia, New York, Boston, and other cities on the Atlantic coast.

In the early days of Western pork packing the slaughtering was, to a large extent, a distinctive business from the curing operations. The packer confined himself largely to the cutting and curing of dressed hogs. The farmer in those early days slaughtered his own hogs on the farm, in the months of December and January, the neighbors usually assisting; and he sold whatever he could spare over and above the needs of his own family to the nearest storekeeper, or to the small packer, who, located at some convenient point, cut up the dressed hogs, cured the product, and shipped it South, as I have already mentioned. Sometimes, indeed, the packing-house took the form of a flatboat on the river, the curing, such as it was, being done on board. When the spring "break-up" came the flatboat was floated down the river, and the product exchanged at Cincinnati, Louisville, St. Louis, and New Orleans, for sugar, molasses, rice, and other merchandise.

Chicago's place in the packing business is preëminent to-day, but it was not always so. In 1845 a Cincinnati journalist published the following statement:

"The putting up of pork has been so important a branch of business in our city for five and twenty years as to have constituted its largest item of manufacture and acquired for it the soubriquet of 'Porkopolis.' . . . Our pork business is the largest in the world, not even excepting Cork or Belfast, in Ireland, which country puts up and exports immense amounts

in that line; and the stranger who visits Cincinnati during the season of cutting and packing hogs should on no account neglect making a visit to one or more slaughter-houses and pork-packing establishments in the city.

"It may appear remarkable, in considering the facility for putting up pork which many other points in Illinois, Indiana, Ohio, and Kentucky possess, in their greater contiguity to the neighborhoods which produce the hogs, and other advantages which are palpable, that so large an amount of this business is engrossed at Cincinnati. It must be observed, however, that the raw material in this business—the hog—constitutes eighty per cent. of the value when ready for sale, and, being always paid for in cash, such heavy disbursements are required in large sums, and at a day's notice, that the necessary capital is not as readily obtainable elsewhere in the West as here. Nor, in an article which in process of curing runs great risks from sudden changes in weather, can the packer protect himself, except where there are ample means in extensive supplies of salt, and any necessary force of coopers or laborers to put on in case of emergency or disappointment in previous arrangements. More than all, the facilities of turning to account in various manufactures, or as articles of food in a dense community, what cannot be disposed of to profit elsewhere, render hogs, to the Cincinnati packer, worth ten per cent. more than they will command at other points in the Mississippi Valley."

In the Cincinnati "Price Current" of November 16, 1844, it was mentioned that a large pork-packing house had been established at Louisville, and the Louisville "Journal" was quoted as saying: "Heretofore all the pork killed here has been packed at the slaughter-houses, and the purchases have been in gross; but the packing-house on Pearl Street will now enable dealers to purchase the net pork at the slaughter-houses and have it packed in the city, precisely as this business is done in Cincinnati."

The "Price Current" in the same month said: "The number of regular packing-houses at Cincinnati is found to be twenty-six, the most of them prepared to do a pretty extensive business, as far as the necessary conveniences are concerned; but only a small proportion of them will pack to any considerable extent on their own account." In 1853–54 the number of packing-houses there was forty-one; in 1855–56, forty-two houses. Among the various points in the region of the Ohio and Mississippi rivers where hogs were packed in considerable numbers in the forties were Columbus, Chillicothe, Circleville, and Hamilton, in Ohio; Lafayette, Lawrenceburg, Madison, Terre Haute, and Vincennes, in Indiana; Alton, Beardstown, Pekin, Peoria, and Quincy, in Illinois; and many places of minor importance. The greatest number of places engaged in the hog-packing business was reported in 1873–74, 397 places being included in the official reports; and since that time the number has steadily declined, the process of concentration in the large centers going steadily on, the number in 1894–95 being only 76.

The first effort at a definite statement of pork packing in the West was instituted by Charles Cist, of Cincinnati, in the winter of 1832–33. The "Price Current" of that city, which was started in January, 1844, by A. Peabody, inaugurated a more complete system of investigation, and this publication has continued such statistical work, with a very greatly widened scope of investigation in recent years, the trade now relying upon its weekly and annual statements for information concerning this industry. I am indebted to my friend, Mr. Charles Murray, the present editor and proprietor of the "Price Current," for most of the statistical information incorporated in this article.

The first season in which the Western packing reached a total of 1,000,000 hogs was in 1843–44, the number falling below this point during the next three years. The following table shows the number of hogs packed in the West up to the beginning of summer slaughtering operations:

HOGS PACKED.

Year.	Number Packed.	Year.	Number Packed.
1842–43	675,000	1857–58	2,211,000
1843–44	1,245,000	1858–59	2,465,000
1844–45	790,000	1859–60	2,351,000
1845–46	940,000	1860–61	2,156,000
1846–47	825,000	1861–62	2,893,000
1847–48	1,710,000	1862–63	4,069,000
1848–49	1,560,000	1863–64	3,261,000
1849–50	1,652,000	1864–65	2,423,000
1850–51	1,333,000	1865–66	1,788,000
1851–52	1,183,000	1866–67	2,401,000
1852–53	2,201,000	1867–68	2,781,000
1853–54	2,535,000	1868–69	2,500,000
1854–55	2,124,000	1869–70	2,635,000
1855–56	2,490,000	1870–71	2,695,000
1856–57	1,818,000	1871–72	4,831,000

Prior to 1872 summer slaughtering had not reached proportions of importance. In that year 500,000 hogs were killed during the season, and subsequently, with the introduction of chilling processes, summer killing developed into large proportions, as is shown by the following comparison

Philip D. Armour.

of yearly totals for the summer and winter seasons, and the aggregates:

HOGS PACKED.

Year.	Summer.	Winter.	Twelve Months.
1872-73	505,000	5,410,000	5,915,000
1873-74	1,063,000	5,466,000	6,529,000
1874-75	1,200,000	5,566,000	6,766,000
1875-76	1,262,000	4,880,000	6,142,000
1876-77	2,308,000	5,101,000	7,409,000
1877-78	2,543,000	6,505,000	9,048,000
1878-79	3,378,000	7,480,000	10,858,000
1879-80	4,051,000	6,950,000	11,001,000
1880-81	5,324,000	6,919,000	12,243,000
1881-82	4,803,000	5,748,000	10,551,000
1882-83	3,211,000	6,132,000	9,343,000
1883-84	3,781,000	5,402,000	9,183,000
1884-85	4,059,000	6,460,000	10,519,000
1885-86	4,964,000	6,299,000	11,263,000
1886-87	5,644,000	6,439,000	12,083,000
1887-88	5,611,000	5,921,000	11,532,000
1888-89	5,315,000	5,484,000	10,799,000
1889-90	6,881,000	6,664,000	13,545,000
1890-91	9,540,000	8,173,000	17,713,000
1891-92	6,696,000	7,761,000	14,457,000
1892-93	7,757,000	4,633,000	12,390,000
1893-94	6,721,000	4,884,000	11,605,000
1894-95	8,812,000	7,191,000	16,003,000

The summer season covers the period of eight months, from March to October inclusive, and the winter season four months, November to February inclusive, in these exhibits. For the past ten years the summer packing represents nearly fifty-two per cent. of the aggregate. It is here shown that from a business of about 1,000,000 hogs, as the yearly extent of Western packing operations fifty years ago, the growth of this industry brought the annual average for the following decade to 1,606,000, during which period the largest total was 2,535,000, in 1853-54; for the next decade, 1855-56 to 1864-65, the annual average was advanced to 2,613,000 hogs, the largest number being 4,069,000, in 1862-63; for the following decade, 1865-66 to 1874-75, the annual average reached 3,993,000 hogs, with 6,766,000 as the largest number, in the last year of the period; for the next decade, 1875-76 to 1884-85, there was a more striking advance, the annual average representing 9,015,000 hogs, with 12,243,000 as the largest yearly number, in 1880-81. Again a large increase is shown for the past decade, ending with 1894-95, for which the annual average is 12,139,000, and 17,713,000 the largest yearly number, in 1890-91.

For the ten years ending with 1851-52 the packing at Cincinnati represented twenty-seven per cent. of the total for the West, that city reaching 475,000 hogs in 1848-49. At that time the industry had scarcely been inaugurated at Chicago, and was of unimportant proportions at St. Louis, while Milwaukee, Kansas City, Omaha, and other towns were unknown in the packing lists. Railroads penetrated the West in 1852, and by 1855 several roads were in operation. This influence, tending, as it did, to open up the country to settlement, and facilitating the exchange of commodities, had a marked effect on the extension of the packing business, and in changing its geographical position and its character. At Chicago about 20,000 hogs were killed in 1850-51, and the increase at this point from that time on was rapid. In 1858-59, 99,000 hogs were killed in Chicago; 505,000 in 1861-62; 1,225,000 in 1871-72; 4,009,000 in 1877-78; 5,752,000 in 1880-81; and in 1890-91, 6,071,000, by far the largest yearly total for one city in the history of the industry, Kansas City coming second with 2,398,764 in the same year.

Until 1861-62 Cincinnati continuously maintained its position as the leading packing point in the country. In that season the distinction passed to Chicago, where it has remained, and is likely to continue for a long time. Of the aggregate of 131,000,000 hogs handled by Western packers in the past ten years, Chicago represents 46,000,000, or thirty-five per cent. During the past ten years Western packers have paid out $1,429,000,000 for hogs, or an annual average of about $143,000,000, reaching $172,679,000 for the year ending March 1, 1895. These figures relate only to the manufacture of hog products, and to the business in the West prosecuted for commercial purposes.

While curing operations were carried on in Eastern markets at an earlier period, what may be termed regular packing establishments probably were not established there until after the industry had been developed in the West. The following is a statement of the reported sales of beef-cattle, sheep, and hogs at Boston, New York, Philadelphia, and Baltimore, in the year 1844, most of these animals being undoubtedly slaughtered for local consumption in a fresh state:

ANIMALS SOLD IN FOUR EASTERN CITIES IN 1844.

	Cattle.	Sheep.	Hogs.	Total.
Boston	43,530	98,820	43,060	185,410
New York	49,002	75,713	13,478	138,193
Philadelphia	37,420	91,480	22,480	151,380
Baltimore	33,500	90,450	24,000	147,950
Total	163,452	356,463	103,018	622,933

The aggregate value of the 623,000 animals marketed in the four large cities in one year, fifty years ago, was $7,500,000. For the year 1894 the receipts of cattle, sheep, and hogs at Boston, New York, Philadelphia, and Baltimore were as follows:

ANIMALS SOLD IN FOUR EASTERN CITIES IN 1894.

	Cattle.	Sheep.	Hogs.	Total.
Boston	182,276	688,334	1,664,671	2,535,281
New York ...	564,932	2,436,842	1,656,435	4,658,209
Philadelphia..	170,960	591,985	363,671	1,132,616
Baltimore	154,958	361,722	602,996	1,119,676
Total	1,079,126	4,078,883	4,287,773	9,445,782

The total value of the 9,445,000 animals represented in the foregoing exhibit for 1894 was approximately $140,000,000. There were exported 421,000 live cattle, valued at $38,963,000, leaving approximately 9,000,000 animals for local slaughtering establishments at the seaboard, and representing about $100,000,000 in value.

For many years a number of large packing establishments have been in operation in Eastern cities, notably at Buffalo, Boston, Providence, New Haven, and Springfield. At about fifty establishments in New England, New York, and Pennsylvania from which returns of packing have been obtained, the total packing for the year ending March 1, 1895, was 3,098,000 hogs. The total of these establishments ten years ago was 1,550,000, which exceeded any previous year. The hogs slaughtered the past year at the seaboard and other Eastern localities represented a value of about $60,000,000, which with the amount paid out by Western packers makes a total of $232,000,000 for the year's outlay for hogs, or an average of about $750,000 daily.

These statistics indicate in general terms the significant progress of the pork-packing industry in the United States, which we may say really had its beginning about seventy-five years ago. The limits of this article will not permit me to explain in detail how this vast quantity of meat is to-day handled and prepared for market. Naturally, labor-saving devices have been adopted as pressing needs demonstrated their necessity. The killing is done by hand, no mechanical means of wholesale slaughter having been evolved; but in the manipulation of the carcass many ingenious contrivances are utilized. The scalding and the scraping of the hog used to be a slow and tedious job; but to-day as soon as life has left the animal he is hooked by the nose to an endless chain, passed through the scalding-vats, and through an automatically adjustable scraper, where he is deprived of his hair and bristles in a few seconds; he is then hoisted, head down, upon an inclined rail; and is disemboweled, beheaded, washed, trimmed, and whirled off to the chill-rooms at the rate of twenty hogs a minute. The cutting and curing of the hog, too, is different from the custom of early days. Hams, shoulders, sides, or barreled pork, comprised the selling list of thirty years ago. To-day the variety of cuts is bewildering to an outsider. The world is to-day the packer's market, and he has to study the peculiarities and preferences of each country, and even each county. The influence of English county idiosyncrasies in the cutting and curing of home-killed bacon is reflected to-day in our cuts. Wiltshires, Cumberlands, Staffordshires, Yorkshires, etc., are only a few of such distinguishing styles.

No one factor has done more to render possible the development of the last twenty years in the slaughtering, curing, and packing of meats than the discoveries securing and improving artificial refrigeration. At the bottom of all successful meat curing lies the proper and thorough chilling of the carcass. The packing season is now twelve months long, and summer-cured meat differs in no material respect from that cured in winter.

Beef packing was among the earliest of operations in the curing of meat for transportation to other localities, as well as for preservation for home demand. Barreled beef was put up in the West in considerable quantities as early as pork, and probably earlier, and transported by water to the Eastern markets; and beef packed at Boston, New York, New Haven, and other Eastern cities found its way all over the world on shipboard.

The canning of beef was attempted in Chicago in the sixties, and enjoyed some little growth; but it was not until the year 1879 that the beef-canning business was taken up on a large scale by the packers. Mechanical ingenuity, in discovering a sure and practicable method of hermetically sealing tins, rendered possible the preservation of food in this way on a large scale; and the facilities already secured by the large packers for disposing of every part of the animal placed the business entirely in their hands. The convenience of canned beef, tongues, potted meats, and soups, and the fact that they could be guaranteed to keep sound in any climate for years, combined to steadily increase this branch of the industry. In 1890, 111,000,000 pounds of canned beef were exported.

The dressed-beef trade, which now forms so large a part of the packing business, had little importance prior to 1875. The settlement of the West, and the rapid increase in the numbers of cattle on the Western ranches and farms, afforded a new and bountiful addition to the world's food-supply; but it was not until the invention and development of refrigerator-cars that the food which the world lacked was brought in quantity, and in good condition, to its table. The exportation of fresh beef had its beginning in a moderate way in the early months of the year 1876, and was enlarged with the later months, making a total of 19,838,000 pounds for the year. For five years, ending with 1880, the average was 59,000,000 pounds, reaching 100,622,000 pounds in the last year of the period. For the next ten years the annual average was 113,000,000 pounds, reaching 182,500,000 in the last year of the period. For the past four years the average was 203,000,000 pounds, reaching 233,000,000 pounds in 1892. At first the cattle were transported on the hoof, and handled in the Eastern cities by the local abattoirs; but the long and tiresome journey was bad for the beef, and this method had to give place to something less wasteful and more humane. The large hog-packing establishments which had already grown to prominence in Chicago afforded the necessary means of effecting the revolution. There the offal could be manipulated to better advantage than elsewhere. Mechanical skill, as I have said, provided the refrigerator-car, cold-air machines, and a number of other devices. The packer to-day slaughters thousands of head of cattle daily, chills the carcasses at a uniform temperature, whether in midwinter or in the "dog days," loads the beef, after thorough chilling, into his own refrigerator-cars, in which a uniform temperature is maintained between Chicago and the Eastern markets, delivers the beef into his own cold-storage warehouses in the large Eastern centers, and distributes the carcasses to the local butchers at a lower price and in better condition than the local beef slaughtered by themselves, and in vastly better condition than the meat which they previously obtained from cattle shipped on the hoof 1500 or 2000 miles by rail. If the meat is intended for export the packer runs his refrigerator-cars alongside the ocean-liners, and transfers the meat to the specially constructed chill-rooms of the steamers, and lands the beef in London, Liverpool, and Glasgow in prime condition and at a low price. There is good ground for the view that the cattle-raising industry of the West has been greatly benefited by this extension of slaughtering through the development of the dressed-beef trade.

Definite figures illustrating the growth of the slaughtering of cattle for commercial dressed beef are unfortunately very meager; but the general purpose of such information is served by the introduction of statistics indicating the number of cattle killed at prominent Western markets where this industry is prosecuted. The following compilation shows the average annual number of cattle killed in periods of five years, from 1871 to 1890 inclusive, and the average annual number for the four years ending 1894, at the places named:

CATTLE KILLED IN FOUR WESTERN CITIES.

Period.	Chicago.	St. Louis.	Kansas City.	Omaha.
1871–75....	190,000	104,000	37,000	......
1876–80....	411,000	165,000	60,000	.....
1881–85....	864,000	182,000	82,000	10,000
1886–90 ...	1,696,000	210,000	341,000	170,000
1890–94 ...	2,223,000	303,000	756,000	460,000

The killing of cattle for supplies of commercial product has also been prosecuted at various other points in the West, including Milwaukee, Sioux City, Indianapolis, Cincinnati, and Cleveland.

The following is a comparison of the number of cattle killed in 1871, 1880, 1890, and 1894, at the large Western markets mentioned, with the total receipts at Boston, New York, Philadelphia, and Baltimore for the same years, with totals for Western and Eastern markets mentioned:

CATTLE KILLED AND CATTLE RECEIVED.

	1871.	1880.	1890.	1894.
Chicago..........	141,000	496,000	2,224,000	2,023,000
St. Louis..........	69,000	196,000	227,000	492,000
Kansas City	20,000	50,000	549,000	925,000
Omaha	......	.... .	323,000	518,000
Four Western centers	230,000	742,000	3,323,000	3,958,000
Seaboard	745,000	1,268,000	1,280,000	1,079,000
West and East..........	975,000	2,010,000	4,603,000	5,037,000

The aggregate value of the 5,037,000 cattle in 1894 in the several markets where they were killed, including the number exported alive (421,000), was approximately $235,000,000.

Incident to traffic in dressed beef, the mutton trade has assumed important proportions in late years, this product being largely distributed in the refrigerator-car shipments of meats. The following figures show the number of sheep killed in the four Western centers and received at the seaboard cities in the years 1871, 1880, 1890, and 1894:

SHEEP KILLED IN FOUR WESTERN CENTERS AND RECEIVED AT SEABOARD CITIES.

	1871.	1880.	1890.	1894.
Sheep, West..	261,000	405,000	1,621,000	3,564,000
Sheep, East...	2,793,000	3,005,000	3,274,000	4,079,000

The published records of the Census Office do not give figures showing the capital invested in the packing business earlier than 1870. The official figures for 1870, 1880, and 1890 are as follows:

1870	$22,124,787
1880	49,419,213
1890	116,887,504

Even after the packing business had assumed fairly large proportions, the packers were not aware of, or did not appreciate, the value of the offal, and the problem of how to get rid of it at the least expense was ever present. So recently as twenty-five years ago, in Chicago, the blood was allowed to run into the river, and men were paid five dollars a load to cart the heads, feet, tankage, and other waste material out upon the prairie and there bury it in pits and trenches. Instead of being a source of profit, the offal, in this respect, was a distinct source of expense. Gradually there grew up in the vicinity of the packing centers subsidiary enterprises having for their object the utilization of some or all of this waste material. Such concerns turned out glue, oil, tallow, and crude fertilizers. In time, however, the necessities of the business, and the growing competition, forced the progressive packer to include these industries in his own establishment. It became less profitable to pack in a small way, and to-day a large packing plant depends largely for its profit on the intelligent utilization of those so-called waste materials which in the early days of the packing business were not only thrown away, but the removal of which was, as I have shown, an actual source of expense.

In all this packing business, whether it is in beef or hogs, the waste which previously prevailed when the animals were handled one by one by local butchers, or were handled on even a slightly larger scale by the numerous small packers that were scattered over the States of Ohio, Indiana, Illinois, Iowa, and Missouri, or in the East, is, by the present methods, entirely obviated. It is the aim that nothing shall be wasted. The large packing establishments of to-day manipulate their own horns, hoofs, bones, sinews, hide-trimmings, etc., in their own glue-works. The sweet fat of the cattle forms the basis of butterine, made in their own butterine factories; the sheep pelts are scoured, and the wool removed in their own wool-houses, cleansed, and sold direct to the large Eastern cloth-mills. The intestines are cleansed and salted and used for sausage casings in their own sausage factories. The blood and all animal refuse are treated by their chemists in their own fertilizer factories, with a view to the scientific preparation of fertilizers to suit different soils; and in one or two packing houses there has been established a laboratory where the inner lining of the hog's stomach is made into pepsin of greater purity and activity than was possible when the sensitive material had to be transported in a raw state, and subjected to all the risks of decomposition and consequent loss of digestive power.

I do not know of any business in which the development has been so marked in the same length of time as in the packing business. It seems a "far cry" from the packing-house which consisted of a flatboat on the river to the packing-house of to-day, which owns and operates, as part of its equipment, 6000 refrigerator-cars; but the distance as measured by the lapse of time is only fifty years. I do not care to venture a prophecy as to the future. I shall leave that to the genial editor who writes, I understand, on the "Next Hundred Years." The population of the United States in 1871 was about 39,500,000; in 1880, 50,155,000; in 1890, 62,622,000; in 1894, about 68,000,000. The population in 1894, as compared with that of 1871, was as 172 to 100. The total number of animals marketed in 1894, as compared with 1871, was as 306 to 100. The fierceness of competition may force the packing-house of twenty-five years hence to include a tannery, a boot and shoe factory, a cloth-mill, and a mammoth tailor-shop, and the tendency to concentration may be still further intensified; but the packing business as a whole seems destined for greater development, and should grow with the country's growth.

Philip D Armour

Eugene G. Blackford.

CHAPTER LVI

AMERICAN FISH FOODS

IT is conceded that the search for gold was in a measure one of the propelling forces of discovery; but the quest for food, and particularly for fish food, must also be considered as a reason for the love for wandering. This double incentive was conspicuously shown in 1614. Captain John Smith, in describing "New England, a part of America, at the Isle of Monahiggin," writes, "Our plot was there to take whales and make trials for a mine of gold and copper. If this failed, fish and furs was then our refuge, to make ourselves savors howsoever."

The earliest knowledge that edible fish of the kinds known in the old world were to be found in abundance in the waters of the new dates back to the time of John Cabot and his son Sebastian. Under a charter granted by Henry VII., John and Sebastian Cabot reached, in June, 1497, what was probably the coast of Labrador. We find on a map of somewhat later date (the authenticity of which cannot be questioned) a land which bears the name "Tierra de los Bacallaos," which, in English, is "the Land of the Codfish." Philologists are often struck by what may be called the resistance of a word to all changes. J. Carson Brevoort has shown in the most convincing manner that the Greeks, the Latins, the Iberians, the English, and the Dutch all derived the name "cod" from the small stick, gad, or rod used in drying the gadus, and baculeum in Iberian is a small stick, hence the Spanish baccalaos or dried cod.

In 1415, as stated by Prof. G. Brown Goode, English vessels frequented the fishing-grounds of Iceland, and it is not impossible that these ships sailed further westward in search of the cod. If tradition is worth anything, the probabilities are strong that the hardy Basques reached the northern coast of America centuries before Columbus did. "The banks of Newfoundland were among the principal inducements which led England to establish colonies in this country, and in the records of early voyages are many allusions to the appearance of cod." (Goode.)

Less than a century later, an adventurer petitioned Queen Elizabeth (1577), offering to "destroy the great Spanish fleet which went every year to the banks of Newfoundland for fish for their fasting days." Eleven years later (1585), when war was imminent between England and Spain, Barnard Drake was commissioned to proceed to Newfoundland to warn "the English fishery there of the trouble." In 1600 there are records which show that England employed 200 vessels and 1000 men and boys in the New England fisheries. With the settlement of Virginia the excellence of the fish on the southern coasts was cited. "A bold channel so stored with sturgeon and other sweet fish as no man's fortune has ever possessed the like" (1607). George Percy wrote to England of "the good mussels and oysters of Virginia" (1606). There is a record of the same time describing an encounter with the Indians of Virginia, who, having been driven off, "fled, leaving many oysters in the fire." The presence of salmon (sallos) in Virginia is indicated by a document found in the Simancas archives. There is a curious fragment of verse which has come down to us, written by Drayton (1619–20), entitled "An Ode to the Virginia Voyage," where the adventurers are "to get the pearle and gold."

In the study of fish as food, comparing the long past with the immediate present, one marked difference is in the method of preservation. Among aboriginal races, more particularly those living in the far North, climatic conditions permitted conservation of fish by the simplest methods of drying, but such measures were not possible in warmer zones. The method of salting and drying fish, as practised in Scandinavia, is of the most remote antiquity. Smok-

ing fish in order to prepare them for eating, it is believed, is of a later date. In the earlier times it must have been necessary that a catch of fish should be at once landed so that it could be marketed. Later came the preparation of fish for future use by salting and drying. If the port of final destination were far distant, a convenient shore in the proximity of the catch had to be found, so that the fish might be cured. The early Norseman or Basque of the twelfth and thirteenth centuries, or the English, French, or Spanish fishermen of the sixteenth and seventeenth centuries, must have sought such curing-grounds, so that fishing interests had much to do with the early founding of colonies.

Modern methods of preserving fish are refinements of older processes, the result of a better scientific acquaintance with the composition of food. If there always must exist a demand for cured fish, because it can be kept over, and has the advantages of small bulk and high nutrient quality, nevertheless the demand for the more natural fresh fish remains constant. The first use of ice on board of fishing-smacks, it is believed, was by the fishermen of the American colonies, the practice always having been in vogue among the New England fishermen. The reason for it is plain; the low temperature of New England furnished an abundance of ice during the winter, but in summer the heat was excessive, and fish would spoil. In England and France ice always has been, in the past as in the present, an expensive luxury.

The credit for the refrigerating of fish on a large scale is to be accorded to Enoch Piper of Maine, who first perfected it in the British Provinces. This method is now general in all the large cities on the American seaboard. The advantages of the refrigerating process are evident. In former times, when there was a glut of fish, it often had to be destroyed, because the expense of handling amounted to more than the price offered. To-day, no such waste is possible. Whenever fish is landed at the large cities, and is low in price on account of catches in excess of immediate demand, such fish are bought at a fair price and stored in refrigerators. In this way the labors of the fishermen are not lost, and the stock of food is increased.

Sometimes the idea has been advanced that coöperative methods, such as are successfully carried out by dairymen, should be used by fishermen. It has been proposed that desiccating establishments should be organized in the neighborhood of fisheries, where the excess of fish might be dried by means of approved apparatus.

An important factor in the extensive use of fish is a more expeditious method of transportation. By means of rapid transportation, fish from all portions of the United States reach in a short time the main centers, and distribution on a large scale becomes possible. By actual comparison, it is found by looking over the list of fish offered for sale every day in New York, Philadelphia, Boston, and Chicago, that the variety offered far exceeds that to be found in London, Paris, or Berlin. The large centers of European population require fish, but those living at some distance from the capitals have it only in sparse quantity. This arises from want of a better system of distribution, or from indifference on the part of those who supply the markets. In the New York fish markets, as in those of other great centers of the United States, fresh fish may be found at all times in excellent condition, coming from every portion of the country. There are no waters, salt or fresh, from Alaska to the Gulf of Mexico, which do not contribute their fish to the general markets. Even salmon from Kamtschatka, via Bering Strait, have been found in Fulton Market, New York.

The natural increase of any population requires a larger supply of all kinds of food, but there is another factor to be considered in this—a brief study of fish alimentation in the United States. In proportion to the flesh of domestic animals eaten in this country, the quantity of fish consumed per capita is larger than elsewhere. If there should be the least decrease in any staple article of food, no matter whether derivable from an animal or vegetable source, such diminution would be at once attended with the gravest consequences. Has, then, the supply of fish been equal to the demand?

For the elucidation of a question of this character, not a general but a special area of water, with reference to the catch, should be studied. As has been before presented, the fishing-banks of Newfoundland, first discovered by the Cabots, gave abundance of fish during the sixteenth century. Though statistics of fishermen cannot be presented with precision, since we learn that in Queen Elizabeth's time there were "a thousand English men and boys" fishing there, we may safely believe that, counting the Spanish, French, and Dutch fishermen working over the same grounds, there were some 5000 men employed. For almost 400 years these same waters of the Atlantic have been fished,—and by an array of fishermen ever increasing,—who have employed for the last century very much improved methods of taking fish; yet it cannot be said that in these waters the staple fish, the cod, has shown any appreciable

diminution. A vastly increasing quantity of fish only could have sufficed the business demands of the more numerous fishermen. This constant presence of fish is not singular to American waters. The same conditions of perennial abundance occur in European waters. The European herring, or other fisheries, are of the remotest antiquity, yet they still bear the stress of the vast requirements of to-day.

It may then be laid down as a general rule, that so far as pelagic or deep-sea fish are concerned, in contradistinction to the capture of fish living in close proximity to the coast, the supply of such deep-sea fish is well-nigh inexhaustible, as man's effort to diminish their number has so far been without appreciable effect. This was the conclusion arrived at by the late Professor Huxley in his exhaustive study of the English fisheries. It is not, however, to be questioned, that from causes beyond our comprehension certain kinds of fish are in abundance one year and scarce the next. This may be the case of one special fish, but not of all the fish frequenting known areas of water. The error made by the superficial observer is to give too great prominence to the absence of special fish in a particular year. When systematic research is made, extending over periods of twenty or fifty years, the average quantity of pelagic fish is found to be the same. A particular fish may be scarce in certain waters while abundant in others. Fishermen, when the catch is poor off the coast of Massachusetts, naturally complain, but are ignorant of the fact that north or south of them these same fish are in abundance.

There are exceptions to this general rule as applicable to the constancy of certain pelagic fish. In former years what was known as the shore cod were in abundance near our coasts. These fish have become comparatively scarce to-day. Whether too many have been caught, so that reproduction became difficult, or for the reason that the sources of food for the fish have been diverted, is not now known. As far as relates to one fish, the halibut, its absence from its former grounds is a well-ascertained fact. That the halibut is scarcest to-day in eastern waters of the United States cannot be questioned. The possibility is that the old halibut grounds have been over-fished.

It is this ignorance on the part of our legislatures of the inexhaustible natural supplies of pelagic fish, which has brought about numerous acts which have only resulted in hampering the fishing interests of the country. The laws of nature are indifferent to human laws. "As early as 1670 laws were passed by the Colony of Massachusetts prohibiting certain instruments of capture, and similar ordinances have been passed from time to time ever since. The first recourse of our State governments has always been in seasons of scarcity to attempt to restore fish to their former abundance by protective legislation." (Professor G. Brown Goode.) In a careful study made of the mackerel, extending over three quarters of a century, there were found periods of abundance and scarcity. "These alternated without the least reference to the alleged causes of over-fishing or any particular cause." If, then, useless laws were made in what was certainly the infancy of American fishing, a better acquaintance with ichthyology should preclude the formulating of any such restrictive acts to-day, so far as deep-sea or free-swimming sea fish are concerned.

So far the subject of fish as a food-supply derived from the sea or ocean has been presented, and an endeavor has been made to show how unwise and useless it is to place any restrictions on the taking of pelagic fish. With fish found in the rivers or lakes the conditions are entirely different. If it is beyond man's power to exhaust the food derivable from the sea, this is by no means the case with fresh-water fish. There are many fish called anadromous, or those which return periodically from salt to fresh water, as the salmon and the shad, and these species would be absolutely exterminated if man so willed it. These fish, born at the source of a river, go down to the salt water at certain periods during their existence, remaining there till, later on, urged by the instinct of reproduction, they return to their places of origin in the same rivers. The period of their return from salt to fresh water, in order to lay their eggs, is when these fish are caught. It is precisely at this time that these fish are of service to man, being in their best edible condition. It can thus be understood how a river could be so cross-barred, by means of nets, as to catch almost every anadromous fish ascending the stream. A practical example of this may be found in the Columbia River, once the finest salmon river in the world. The Columbia has supplied canned fish during the last quarter of the century, and now, from over-fishing, the river is almost depleted of salmon.

The presence of dams for manufacturing purposes may or may not have been an industrial necessity, but such dams have in the past brought about the entire disappearance of salmon and shad in certain New England rivers, for the reason that the fish could not ascend the streams to lay their eggs. It

is therefore wise and proper that State legislators should pass laws regulating the character of the nets to be employed in catching such anadromous fish, and fixing certain periods when fish could or could not be caught, or establishing what are known as close seasons.

Our great North American lakes, when compared with the vast extent of the sea, are restricted areas of fresh water. The range of fish in these lakes is limited, and their habits can be readily determined. If no heed were to be taken as to the seasons of spawning of these lake fish, and their indiscriminate capture were carried out, the inevitable result would be their complete destruction. It is a salutary and just provision, that laws should be passed restricting fishing in the lakes to certain seasons, and regulating the size of the meshes of the nets.

It is therefore evident that with certain fresh-water fish, forming a large proportion of our food, their present or future abundance must depend upon protective legislation. But even then the legitimate supply, bearing in mind the constantly increasing demand, would be notably decreased if it were not for the intelligent methods devised for restocking with fish depleted rivers and lakes, and even in some cases the seas.

Here the newer science of fish-culture becomes important. Fish-culture does not create fish. What it does is to study particularly the spawning habits of fish. It secures the fecundated eggs, hatches them artificially, rears the young fish, cares for them up to the period when they are able to provide for their own wants, and, lastly, introduces the young fry in quantity in those rivers or lakes where, from over-fishing or other causes, the fish are wanting. Fish-culture has to do with our future supply. It plants the fingerling to-day, so that in the years to come the little fish, grown to full size, may furnish wholesome food.

In studying the advance fish-culture has made in the United States it is highly flattering to signalize the practical good sense and enterprise of a private body of citizens, the American Fish Cultural Association, which first directed public attention to the restocking of our rivers and lakes. It was through the influence of this association that the attention of the government was called to the matter, with the result of creating the United States Fish Commission (1871), with that most distinguished man, the late Spencer F. Baird, at its head. With the fullest appreciation of the exigencies of the case, Professor Baird endowed the study of American fish-culture with all the treasures of his scientific and, above all, practical mind, and our country will always be indebted to him for the many benefits he has bestowed upon it.

It is evident that preservative measures will always be necessary in order to keep up the average stock of useful fish in our rivers and lakes, but when we study the condition of the oyster a more serious problem is presented.

The oyster is a type of immobility. If in its embryotic state it is endowed with motion, in its subsequent condition it becomes forever fixed. If the oyster were taken in an indiscriminate manner, in time it would be exterminated. In England and France the supply would have failed long ago had not stringent measures been carried out looking to their preservation. In France efforts were directed toward restocking old beds and the creation of new ones.

The oyster-beds of Maryland and Virginia were at one time deemed inexhaustible, but constant dredging for oysters, the quantity desired being on an ever ascending scale, showed that the beds of Chesapeake Bay were unable to stand the demands made on them. Legislators finally directed their attention to these oyster-grounds, and to other oyster-beds on our North Atlantic seaboard, and with good effects. Grants were established in some cases, making a title to oyster-beds, or municipalities rented oystering privileges. The planting of oysters was encouraged, and laws were formulated regulating the dredging. The chaotic conditions of some fifteen years ago have been changed. Even with the many precautions used it is to be feared, such is the demand for oysters, that our time of plenty has passed, and that the price of the oyster will be increased in the years to come. Methods of establishing new beds by means of oyster-culture have been successfully carried on in France, but do not seem to have been available in the United States. This arises not from any want of knowledge or skill on our part, but because the spat of the American oyster has certain peculiarities in which it differs from the French oyster. The clam is still abundant, nor does there seem to be any reason why for many years to come it will not meet the demand.

Lobsters are becoming scarce. This is caused by their having been over-fished in the first place, and, secondly, because of the indifference of the captors as to the size, condition, and consequently the age of the lobster. In a general taking of lobsters, the small females having been captured, natural chances of reproduction were destroyed. At one time lobsters were fairly abundant in the waters of New

York. To-day, few, if any, are caught. The absence of lobsters from their former grounds upon the North Atlantic seaboard must be noted. Methods of fish-culture applied to lobsters have not as yet been successfully operated. Legal restrictions in regard to the indiscriminate capture of the lobster have been exceedingly difficult to carry out. The demands of the lobster canneries in certain seasons are always on the increase, and supervision is apparently impossible.

Terrapin of the finest variety is becoming very scarce. This is due to the overcapture of the Northern terrapin. In the South terrapins of not so high a quality are still moderately abundant. Fish on our American coast are not taken to serve as food alone. The menhaden is among our valuable fish, as a source whence oil and fertilizing material are derived. With a very much increased force of fishermen, and with more approved methods of capture, the catch of the menhaden is still large. The menhaden shows, as do other pelagic fish, that in certain years they are more abundant than in others.

Looking over a list of fish offered in the New York markets in 1804, it will be found to be made up of some fifty-seven varieties. Deducting from this list two which are rather unusual and not salable to-day, we have fifty-five kinds. To-day seventy-five different kinds of sea products may be seen in any of the wholesale or retail fish markets in the American cities of the seaboard, according to the season. A notable change is to be found in the places from which the fish are obtained. Our great-grandfathers who were captains of fishing-smacks caught the general run of pelagic fish in about the same areas of water as do their great-grandsons, the skippers of the Gloucester or New York fishing fleets of to-day. By means of transportation other sources of fish further north or south furnish the present additional supply.

The greatest exception among the deep-sea swimming fish, as has been before stated, would be the halibut. In 1804 Nantucket shoals, or localities even nearer to New York, furnished the halibut. As time went on halibut was fished for near Labrador; then the waters near Iceland were sought by our adventurous Gloucester fishermen. At present fresh halibut comes in good quantity from Alaska and the far northern Pacific. To-day all the ordinary fish marketed, taking New York as a center, is derived, not only from adjacent seas or rivers, but from waters 800 miles north or 1000 miles south on the Atlantic sea-board.

In presenting such figures as are available, showing the weight and value of the American fisheries for 1870, 1880, and 1890, those of 1870 are not considered by the United States Fish Commission as absolutely trustworthy. The census of our fisheries had not, in 1870, the advantages of the careful supervision of the Commission. Unfortunately, too, that of 1890 is wanting in some details, the work not having been entirely concluded. If, however, errors have been made, experts believe that the statements as to values are rather under than overestimated.

PRODUCTS OF UNITED STATES FISHERIES IN 1870, 1880, AND 1890.

Kinds.	1870.		1880.		1890.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
General fishery products..	....	$11,096,522	1,771,822,000	$36,692,200	2,026,020,900	$42,141,411
Mammalian products.....	....	4,529,126	....	4,613,756	....	2,136,103
Total..	....	$15,625,648	1,771,822,000	$41,305,956	2,026,020,900	$44,277,514

FISHERY PRODUCTS EXPORTED IN 1870, 1880, AND 1890.

Products.	Fiscal Year 1870.	Fiscal Year 1880.	Fiscal Year 1890.
Fish and shellfish	$1,380,601	$4,028,626	$6,040,826
Oils and spermaceti ..	1,049,882	881,131	682,131
Whalebone	343,937	255,847	705,500
Total	$2,774,420	$5,165,604	$7,428,457

In 1875 the value and extent of the fisheries carried on by the port of Gloucester alone was estimated at $4,059,500. In 1876 it was worth $4,648,000. This was one only of many towns which kept out fleets on the Atlantic and in the bays and sounds of New England. For this same year (1876) Professor Baird estimated that the yield of the fish-

eries prosecuted in vessels and from the ports of the United States amounted to:

Kind.	Pounds.
Codfish	71,373,900
Mackerel	30,542,500
Herring	22,328,700
Other fish	11,503,540
Fresh fish not cured	99,677,911

It must be borne in mind that twenty years ago the fisheries of the North Pacific were in their infancy.

It has been possible for the United States Custom House to determine, with a fair amount of accuracy, the total tonnage of vessels employed in the cod, mackerel, and whale fisheries for a series of years. In 1800 the total tonnage was 35,626 tons; in 1820, 1,108,464; in 1840, 241,232; in 1860, 329,605; and in 1880, 115,946. The diminution of tonnage is due to the withdrawal of the large vessels employed in the whale fisheries.

The abstract taken from the last census presents many remarkable features. In 1890 there were 163,348 persons employed, with a capital invested of $43,602,123, returning products worth $44,277,-514. There were 7257 vessels, with a net tonnage of 174,020, worth $11,133,265. Maryland, with her oyster fisheries, had the most men, 36,436; Massachusetts was the next with 16,250 men. New York had 9321 employed. California had 3094 men. Dividing the value of the products, the general fisheries were worth $26,747,440; the whale fisheries $1,697,875; the seal fisheries $438,228; menhaden fisheries $1,817,878; oyster fisheries $13,-294,339; and the sponge fisheries $281,754.

The latest statistics of the fishing business of the States of New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and the District of Columbia (1894–95) show 91,000 people employed. The value of the oyster product alone was $12,400,000. Shad was worth $1,216,000. In the oystering business the investment in Maryland was $7,649,904, and the oyster product represented $5,-259,865. The total weight of the product from the water was 590,454,369 pounds, worth $19,023,474.

The weight of fish caught was:

Years.	Pounds.
1874	295,726,800
1880	465,600,000
1890	332,211,600
1894	324,217,200

The oil exported in 1894 was 430,389½ gallons.

The particulars of the menhaden industry are of great interest, because they are carried out upon the Middle Atlantic seaboard in a more systematic way than any other fishery. The catch, it will be noticed, was the lightest in 1874, and the heaviest in 1880; but the takes in 1890 and the last year far exceeded that of 1874, which tends to prove that with fish having powers to move as they please, man's efforts to lessen their numbers materially by capture become impossible.

A statistical study of the weight and values of fisheries on the Pacific coast, from the waters of San Francisco Bay to Alaska, is not yet possible. On the Columbia River the canning of salmon began in 1866, with 4000 cases, and in 1889 reached 309,885 cases. Then came the exhaustion of the Columbia River. In 1883 the salmon of Alaska were first canned, and in that year 6000 cases were marketed. In 1890 the enormous total was 610,717 cases. In the seven years from 1883 to 1890 this would have meant a consumption of 27,706,958 salmon. There can be no question as to the speedy extermination of the salmon in some of the Alaskan rivers.

As to the cod and other pelagic fish of the Northwestern Pacific waters of the United States, there is no reason to suppose that they are in less quantity than on the Atlantic seaboard. With each succeeding year, these fish from the Pacific will find their way all along the great lines of railroad from the West to the East, and in increasing quantities.

Extensive canneries, many of them devoting their attention to the herring and lobster, are found on the eastern coast of the United States, and they contribute largely to our stock of food. On the California coast the presence of the true sardine has been noted. When there shall be olive-culture in California, sardines, as they are put up in France, will unquestionably be added to our home fish food.

MENHADEN INDUSTRY—SEASONS 1874, 1880, 1890, and 1894.

Year.	Factories.	Sail Vessels.	Steamers.	Men Employed.	Capital Invested.	Number of Fish Caught.	Gallons of Oil Made.	Tons Scrap.	Tons dry Scrap.
1874	64	283	25	2,438	$2,500,000	492,878,000	3,372,847	50,976	......
1880	79	366	82	3,261	2,550,000	776,000,000	2,035,000	19,195	25,800
1890	28	27	52	4,368	1,750,000	553,686,156	2,930,217	21,173	20,339
1894	44	30	57	2,560	1,737,000	540,361,900	1,999,505	27,782	20,332

Fish-culture has been of great benefit to California. The shad, at one time unknown in the Pacific rivers, is now to be found there in abundance, its original progenitors having been taken thither from the Atlantic seaboard. California shad exceed ours in size, and from their abundance are cheaper. The striped bass (*Roccus lineatus*), now abundant in California, is also due to fish-culture.

There is no reason to suppose that there will ever be any diminution in the supply of fish. There is no limit as to the area of American waters where edible fish are to be found. And, as has been shown, there can be no reason why our stock of anadromous fish should ever be sensibly diminished. The only exception recorded so far, as to the constancy of our North American pelagic fish, was the absence of the tilefish. It disappeared some time in 1882, due, it is believed, to a sudden change of temperature in the deep waters. After ten years of absence, the tilefish (*Lopholatilus chamæleonticeps*) has again put in an appearance.

It is needless to dwell further on the present facilities of transportation, which will undoubtedly be increased in the immediate future, nor comment on the very much more perfect means which are applicable to the preservation of all perishable products. The catch of 1895, it is considered, has a value of $46,000,000.

Eugene G. Blackford

CHAPTER LVII

AMERICAN CANNING INTERESTS

THE development in this country of the practical arts pertaining to the hermetical sealing of food, now so well known under the generic title of canning, is an interesting feature of the commercial growth of this country. Evolved from the studious and observant brain of an humble Frenchman, and tested through years of his plodding experience, the new method came amidst the throes of the French Revolution, in the year 1795, a veritable offspring of the First Republic. About fourteen years later the French government, under Napoleon the Great, awarded the discoverer the prize of 12,000 francs, which long before had been offered for a method that would preserve alimentary substances without robbing them of their natural qualities and juices. Nicholas Appert, born in 1750, spent his life in brewing, wine-making, pickling, and the making of confectionery, living over ninety years, and continuing to the last to invest all funds he could obtain in the prosecution of his investigation in these different lines. He died, in 1841, neglected and alone. His children have received some benefit from his labors, the title of Chevalier being borne by a descendant of his to-day, indicating that the cross of the Legion of Honor had been awarded to him in recognition of his merits. This industry, which has now become essentially American, begins, therefore, exactly within the century to which this work applies. Appert had obtained financial assistance from English sources, and as a result we find that, about 1810, his method was being used in the factories of an English firm of purveyors.

In that year, a patent was granted in England to one Peter Durand, for a can, made of tin, to be used in hermetically sealing food, the patent also covering the use of glass, pottery, and other fit material. In the letters patent, it is stated that the new method was communicated to him by a foreigner residing abroad. Ezra Daggett, who was in the employment of this English firm, brought the secret, it is believed, to America between 1815 and 1818. In 1819, he was engaged in the packing of hermetically sealed food by this process in New York city, in company with his son-in-law, Thomas Kensett. The descendants of Mr. Kensett still have some cans of these goods in their possession which were put up in 1822, as the labels show. Salmon and lobster were among the earliest goods packed, and oysters also were preserved, according to these labels. In 1825, a patent was granted to Ezra Daggett and Thomas Kensett for an improvement in the art of preserving. The can was then called a "case," the label containing directions for opening it.

About the same time that Daggett came to America from England, Charles Mitchell arrived in Boston from Scotland. He was born in London, there learning the canning business as an apprentice. He left London in 1820, and on reaching Boston almost immediately entered the employment of William Underwood, who established the firm of William Underwood & Company, in 1822, to hermetically seal food. There is a lack of information concerning the development of the industry during the next twenty years, but it was throwing out roots from the New York and Boston plants. In 1843, the firm of Treat, Haliday & Company were canning lobsters in New Brunswick, and salmon in Maine. There is a supposition that Haliday brought the process from Scotland and joined Treat about 1840. Already there was a known distinction between the French (or Appert) process and the Scotch method. Appert used glass vessels only, but the Scotch method required the puncturing of the tin after the first cooking, and then recooking after the hole was soldered. About 1846, Wells, Miller & Provost had a packing-house in New York, on Front Street, near Peck Slip.; W. R. Lewis & Bro. established a factory at Portland, Me.; and E. C. Wright began packing oysters in Balti-

Edward S. Judge.

more, having obtained his knowledge of the process from Thomas Kensett the first. At this time cans were made by the regular tin-workers, but cappers were becoming a regular branch of the business.

Henry Evans, Jr., a tin-worker by trade, learned the process while working as a capper for Wells, Miller & Provost. In 1848, he went to Eastport to pack lobsters for that firm; in 1851 going to Baltimore and later engaging with Thomas Kensett the second, who had formed a partnership with Ira Wheeler in New York. In 1849, Evans had a factory at Newark, N. J., for Kensett & Company, and here were packed supplies of fresh vegetables for Dr. Kane's Arctic Expedition. These included tomatoes, onions, potatoes, and cabbage. Some time after this Evans went to the West Indies, where he packed for Kensett & Company the first pineapples ever packed in that way in those islands.

About 1850, the business began to develop rapidly, and its history is difficult to follow. The oyster business of Baltimore and the lobster and sardine fisheries of Maine were the principal bases of extension. William Numsen & Sons began work in this business in Baltimore in 1847; in 1849, they were packing cove oysters. Tomatoes, peaches, pears, and other articles were put up about the same time, the process being applied to nearly all the fresh foods in the different canneries. A number of active New Englanders located in Baltimore, embarking in the raw-oyster shipping business, and in time many of them began hermetically sealing oysters. The widow of Thomas Kensett the first sold the secret to Holt & Maltby and others, and thus they got into the cove-oyster packing. This title of "cove oysters" has come to be recognized as the specific name for hermetically-sealed cooked oysters. "Cove" oysters were from coves famous for the size and quality of their oysters, which were located on the west side of Chesapeake Bay, above the Potomac. The canning business has given them immortality.

For the first half of the century the industry was obliged to produce all the supplies it needed by hand-labor, and even after canneries multiplied, the output was necessarily restricted, because of the number of hands required and the cost of the goods, based entirely on hand-labor. This industry is the connecting link between agriculture and manufactures, the can being an essential to the foods in this condition; and the food is the *raison d'être* of the can — useless each without the other. The manufacturing lines that have received an impulse from the introduction of this industry are those that unite in the production of the can, the cases, labels, and canning machinery.

Previous to 1850 the cans were made by hand, usually by cutting out the tin blanks with shears, beating the ends into shape with a mallet over a former of some kind, and cutting the opening with a hand-punch and mallet. Originally the opening was covered on the flat top by a flat circular piece of tin, well soldered down. The first can-making machinery we have any authentic record of was naturally adapted from such as tinsmiths used, they being the first providers of cans for the packers, but in 1849 Evans, at Newark, N. J., introduced the use of the "Pendulum" press, for making can-tops. This same press came to Baltimore in 1851. With this press Evans introduced the crease and convex cap.

The California gold-fever gave a great impetus to the canning industry, and the list of the new firms that entered the business during the ten years from 1850 to 1860 would be too long to insert here, even if it could be made up with accuracy. Two historic firms arose just previous to the close of the first half of the century — Rumery & Burnham of Portland, Me., and Louis McMurray of Baltimore. The former was merged at the close of the war into the firm of Davis, Baxter & Company, a firm then well established. Later, this became the famous Portland Packing Company.

The Civil War gave another impulse to the industry, many of the established firms canning meat on government contracts. The canning of milk, under the title of condensed milk, resulted in a wide extension of the industry as previously carried on. Condensed milk, produced by evaporation and preserved with sugar, became a regular article of commerce; large quantities of it were used by the commissariat of the United States army. In 1860, the New York Condensed Milk Company of New York was in full operation, Mr. Borden being a stockholder of the company. In 1863, William Numsen & Sons of Baltimore were handling such large quantities in this same line that they formed the Baltimore Condensed Milk Company, in which Mr. Borden was also interested. On November 4, 1856, a patent was issued to Gail Borden of New York for this method, and under the same date another for an improved method that dispensed with the boiling.

On April 8, 1862, a patent was issued to I. Winslow of Philadelphia for a new method of preserving green corn, which was the regular Appert process for hermetically sealing goods. Winslow assigned this to J. W. Jones, of Portland, Me. It is understood that Winslow learned this art in France, when on a visit there in 1840. Nathan Winslow of Portland,

Me., is said to have been the first who commercially canned sugar corn, and the Winslow Packing Company has ever since been famous for its canning of this vegetable. There is reason to believe that the industry was first carried into the Mississippi Valley by the same Henry Evans, Jr., who was in Baltimore with Thomas Kensett the second. Evans, who was at that time a member of the firm of Evans, Day & Co., was returning East in 1873, when he happened to lie over at Circleville, Ohio. There he met Mr. C. E. Sears, who was engaged in drying sugar-corn, such as is known as shaker corn. He found he could purchase cut corn, fresh and sweet, at a price per can far below the cost of the corn in the husk at Baltimore. His firm bought largely of it that season, besides fitting up a cannery at Circleville to can it there. The next year, however, the cannery was sold to Mr. Sears. This same factory, greatly extended by Mr. Sears, is now owned and operated by his widow, Mrs. C. E. Sears, so successfully that in 1894 she packed the largest output of sugar-corn of any factory in the West, if not in the world.

In the spring of 1864, the business of canning salmon was begun by the firm of Hapgood, Hume & Company, at Washington, Yolo County, Cal., on the Sacramento River. In two years, salmon became scarce there, and after an inspection tour the firm built a cannery at Eagle Cliff, on the Columbia River, Washington. This factory began operations in 1867. The development of the Pacific Northwest was due more to the salmon industry than to any other single influence.

In 1866, Mr. G. C. Van Camp, of Indianapolis, Ind., began packing all kinds of fruits and vegetables in six-gallon cans, the goods being sold in the city markets by the pint or quart. In 1868, he went into the regular canning business, mostly in No. 2 cans. Mr. G. W. Baker began the canning of sugar-corn in Aberdeen, Harford County, Md., in 1866, and several of his sons still continue in the business.

Between 1877 and 1885 canneries developed in great numbers, Harford county, Md., alone having over 400. At the same time firms spread through all the States of the West, mainly packing sugar-corn and tomatoes. There had been many efforts to introduce machinery into the packing-houses, but it was generally resisted by the employees, led by the cappers, on whom depended the proper sealing of the cans. This important function had been organized into a regular system, one boss capper taking the capping of an entire factory and, in some places, of several factories. For the sake of having experienced cappers in season the firms would keep them employed in making cans during the winter months, so even the making of cans was largely governed by these employees. Machines to do capping had been invented, but proved to be unpractical until, about 1883, Mr. I. H. Cox, of Bridgeton, N. J., introduced a hand-capper which proved a success. Very soon thereafter machines for all kinds of operations in the business were introduced. As machinery multiplied, country canneries increased in number because it supplied the place of hands, which the rural sections lacked. By 1892 the variety of machinery special to this industry had increased to such an extent that in that year, at an exhibition of canners' supplies held in the city of Chicago, in connection with a convention of the Western Packers' Association, Mr. Buchanan, Chief of the Department of Agriculture of the Columbian Exposition, who had been invited to see it, stated to the Chief of the Department of Machinery that it was extraordinary and novel. Almost every operation was done by machinery, and the business of "packers' supplies" has become a large one. The introduction of machinery greatly reduced the price of goods and increased the output. Meantime the old, original method of cooking (or processing, as it is called) the goods in open kettles in plain boiling water was improved upon by adding salt to the water to increase its density and thus gain greater heat and quicker results. About 1858 this was further improved by substituting chloride of calcium for the salt; and later, steam-kettles, having a cover and containing a coil of steam-pipe, were patented by A. K. Shriver and G. W. Fisher, both of Baltimore, and these have superseded all other methods for processing foods. Machinery likewise revolutionized the making of cans, until at present they are made by hundreds of millions in special factories, by "systems" that have almost banished the use of manual labor in their production.

The growth of the industry, the multitude of firms, the rapid cheapening of the goods, and the popularity of the business, which requires hermetical sealing and therefore exclusion of the goods from sight, made the fixing of grades and terms of sale and delivery absolutely necessary. Growing in a century from nothing to a vast industry, and peculiar in its nature, it was entirely without commercial rules. The first commercial organization of packers of canned goods met at Philadelphia in October, 1872, but had only a brief existence. In February, 1883, a Canned Goods Exchange was organized in Baltimore, that city then being the great center and producer of these goods. Mr. A. L. Scott was its

first president, and Mr. R. Tynes Smith its first secretary. The intention was to have regular sales on the floor daily, but this plan was abandoned. It, however, adopted grades for goods, rules and terms to govern transactions, and laid the foundation of commercial procedure for the business.

In 1885 the packers of the Mississippi Valley organized in Chicago under the title of the Western Canned Goods Packers' Association, with William Ballinger, of Keokuk, Ia., as president, and L. G. Seager, of Gilman, Ia., as secretary, and this has been a successful and powerful influence in the business, under the guidance of wise and tireless officers. It is based on the principle of mutual exchange of private statistics among members. The packers of the State of New York organized about the same year, with T. L. Bunting, of Hamburg, as president, and J. G. Gibson, of Utica, as secretary, with quarterly meetings and the statistical principle. Virginia and New Jersey organized about two years later, each locally.

The basis of a national association was laid at Indianapolis, in February, 1889, at a meeting of a number of representatives of the local associations, thus making it of a federal nature; the plan being submitted by Mr. Bunting, of New York. This was consummated at a meeting in Baltimore in May of the same year, by representatives from all the minor associations. Mr. L. G. Seager, of Gilman, Ia., was chosen its first president, and Mr. E. S. Judge, the publisher of "Trade," as secretary. There is nothing of the nature of a trust in the organizations of the packers; they are based entirely on the advantage of mutual information and general business rules.

In 1894, the Peninsula Packers' Association was organized at Dover, Del., with James Wallace as president and C. M. Dashiell, of Princess Anne, Md., as secretary. The "Atlantic States Canned Goods Packers' Association" was also organized in the fall of the same year, at Baltimore, with E. H. Thurston, of Mechanic Falls, Me., as president, and H. P. Cannon, of Bridgeville, Del., as secretary. These bodies are also members of the National Association.

In 1894, there were in the United States over 1900 known canned-goods packing-firms, distributed among forty-two States and operating about 2000 canneries, of which Maryland had twenty-five per cent.; Maine, seven per cent.; New York, six per cent.; Ohio, Illinois, and Virginia, three and one half per cent. each; California, five per cent.; Indiana, three per cent., and the other States ranging from fifty-six factories in Pennsylvania down to one in Arizona. The total output of canned goods is computed to have been about 700,000,000 cans of all sizes and kinds. The principal articles packed are tomatoes, corn, milk, oysters, corned beef, salmon, sardines, peaches, peas, beans, apples, pears, pineapples, small fruits, and pumpkins. They are important in about the order given, although values of the aggregate packs may not run in the proportion of the number of cans.

There is a species of sectionalism about the packing, due mainly to climatic influences. Thus, the principal corn-packing States are Maine, New York, Maryland, Illinois, Iowa, and Kansas. Tomatoes are more southern in their trend — New Jersey, Maryland, Indiana, Virginia, and Kentucky being the heaviest packers, while New York, Ohio, and Illinois have the principal milk-canneries. Cove oysters are confined to Maryland, Virginia, North Carolina, Florida, and Mississippi. Beef has been packed in many sections, but the States north and west of the Ohio now almost monopolize this line of canning. Salmon is now only packed on the Pacific Coast, and Alaska is the main source of supply for the market, the canneries multiplying there as the fish have fled from the over-fishing of civilization.

Maine monopolizes the American sardine-packing, as it does lobster-packing, except what is done in Canadian waters. Peaches are packed principally in Maryland, Delaware, California, and Michigan; Georgia is, however, annually increasing the number of her canneries of this fruit. Peas are packed principally in Maryland, New York, Ohio, Indiana, and of late in Delaware; but many of the States in the upper Mississippi Valley are steadily increasing their output. Beans are of three kinds: string beans, baked beans, and lima beans. The first named are a heavy but profitless pack, being put up in all sections to fill time between other crop seasons; the second have their headquarters in Massachusetts, though New York is a strong second, and the article is being added to the list of packers' products in canning-houses everywhere. Lima beans find most packers in New York, Maryland, California, and Ohio; the Pacific Coast furnishing large quantities that in a mature state come east to be packed in winter as soaked goods. Apples are annually becoming a heavier pack in tin — Maine, New York, Maryland, Ohio, Illinois, Iowa, and Kansas putting up large amounts, and the industry is spreading to the new apple fields of Washington and Oregon. New York and California are the principal packers of pears, Maryland and Delaware also doing much

in them. Pineapples, now one of the favorite fruits in tin, are packed mainly at Baltimore, Md., but the packing of them is extending in all directions. Small fruits have declined in the quantity packed till the pack of 1894 was probably not over one fourth the number of cans put up in a year fifteen years ago. California is the great packing region for small fruits, but a varying amount is annually put up by canners in all sections. Pumpkin is almost entirely confined to the Northern States. Soups are packed principally in New York and Illinois, but the output of this class of goods is being increased by large canneries in several of the other States. There is an almost endless line of varieties of canned goods, from green figs in Mississippi and Texas to turtle in Florida, and dandelions and mince-meat pies in New York.

The annual aggregate value of these goods amounts in an average year to over $71,250,000. At 500 cases to the car and two dozen cans to the case, they would need 58,750 box-cars to carry the pack annually. Besides the market it has made for the agriculturist, it has made a demand for labor in the cannery and its work, which requires at least 400,000 people in the height of the season. They would require over 2,000,000 boxes of tin-plate for the cans, about 30,000,000 cases, and 700,000,000 labels. Such is the business to-day that 100 years ago had just been shown to the public in a foreign country. The genius of this American republic seized on this idea of the humble Frenchman, and has made of it a great industry and a new article of quotation in the markets of the world. Its vastness is due entirely to the ability of the American workmen to secure and consume the good things of life which Heaven sends us and genius preserves for us in all climates and all seasons.

E. S. Judge

Charles Carpy.

CHAPTER LVIII

AMERICAN WINES

THE history of the wine business in the United States is very recent. It is recorded that the first attempt to cultivate American vines by European colonists was made in Florida. It is well known that in 1769 the French colonists of Illinois, near the town of Kaskaskia, made wine from the native wild grapes, and even as early as 1630 the London Company sent French vineyardists to Virginia to plant vines. Many efforts were made in the eighteenth century to introduce the tender European vine, and to adapt it to the harsh climate of the Eastern States; but without exception the attempts proved abortive.

In the nineteenth century there must have been several hundred failures in the same attempt, and in 1851, Downing, writing in the "American Horticulturist," said: "The introduction of European vines in America for cultivation on a large scale is impossible. There is first a season or so of promise and then complete failure."

Several of the French settlements in the Ohio Valley succeeded in raising grapes to a limited extent, and early in the century some Swiss from Vevay planted a town in Indiana and attempted the culture of vines on a large scale; but it proved unsuccessful, although a certain quantity of wine was produced. The first successful grower was Longworth, of Cincinnati, who in the forties and fifties raised many grapes and produced some wine. It was of his Catawba wine that Longfellow wrote his inspiring lines. Many other kinds were tried at the time, and while Mr. Longworth lived, a fair return was secured, although possibly at too great a cost, for Cincinnati is not now a grape center. Commercially speaking, wine making was not carried on to any extent in the Eastern United States before the Civil War. Underhill, in his vineyard upon the Hudson, and a few others, made wine; but the sale was small, although grapes were beginning to be produced in abundance. The islands in Lake Erie, which were perhaps the first wine-producing centers of the Atlantic States, practically began to be known about 1857.

The history of vine cultivation in California is like a romance. Where the earliest vines came from no man knows; but, under the familiar cognomen of the "mission" grape, the vine was brought supposedly from Spain by way of Mexico. It was cultivated to a considerable extent around the old missions which were founded in southern California during the second half of the last century. The priests planted small tracts close to the missions, cared for the vines jealously, and surrounded them by high adobe walls. The cultivation was careful, and an abundance of fruit was grown, from which wine was made. What the latter was can be judged from the harsh qualities of the small quantity of mission claret made in California to-day. As far as can be learned, the product of the vineyards of the mission fathers did not enter into the trade of those days, which was largely in hoofs, hides, and tallow; but their wines were used upon the tables of the priests, served to the occasional visitors at the missions, and dealt out to the immediate retainers of each establishment.

Even after the arrival of the American settlers, in 1849, as well as of representatives from every nationality on the globe, next to no advance was made toward increasing the area of land devoted to viticulture until the year 1858, when, through the publication of articles devoted to wine growing, in the report of the State Agricultural Society and in the newspapers, a wide-spread interest was manifested in vine planting, and the area thus required in California was suddenly largely increased.

Many of the vineyards planted in the years immediately after 1858 were devoted to grapes for table use, and the remainder were almost exclusively planted with the old mission grape. The centers of production in those days were in southern California

(in the San Gabriel Valley, and about the old town of Anaheim) and in the Sonoma Valley around the town of Sonoma.

Toward 1862 vine planting became almost a matter of general enthusiasm. In 1861 Governor John G. Downey appointed three commissioners to report upon the best ways and means of promoting the improvement and cultivation of the vine. One of these commissioners went to Europe, and, after visiting all the European districts, made an elaborate report upon the methods of cultivating the vine, making wine, and curing raisins, bringing with him on his return 200,000 grape-vine cuttings, with rooted vines of every obtainable variety to be found in Europe, Asia Minor, Persia, and Egypt. This collection embraced about 400 varieties, and in it was brought, presumably from Hungary, the Zinfandel, which has been so prominent in the later production of wine in California.

Between 1870 and 1875 the making of wine had so largely increased that the consumption was more than met. As a natural consequence, in compliance with the laws of trade, there was a great depression in prices, and many vineyards were rooted out. In 1879 the demand again caught up with the supply, and there was a new era of vine planting. It was not until 1880 that the great body of viticulturists of that State had begun to believe that other varieties of grapes, aside from the old mission, were suitable for wine making. Before that time few believed that any grape could be as good as the mission. Experience, however, has proved that California soil is well adapted to the fine varieties of European grapes. In point of fact, most of the vineyards there are planted with varieties more hardy, more resistant to disease, more consistent bearers, and producing finer qualities and greater quantities than the mission ever succeeded in doing, even under the most favorable conditions.

Following the persistent efforts of enterprising viticulturists, the great quantity of the wine made is now produced from imported varieties, whose character is so distinct, and whose quality is so superior to wines made from the mission grape, that new faith in the future of California wines has been born; and the belief has spread that under proper conditions the State makes wine of a high average grade, and eventually may rival some of the classic growths of the Medoc and of Burgundy.

The new era began in 1880. In spite of the efforts made by wine makers and wine merchants, only a limited market had been secured for California wines in Eastern States, plainly shown by the fact that the total shipments out of the State by sea and by rail in that year were but 2,487,353 gallons, valued at $1,343,170, while the exports of this year (1895) are expected to approximate 15,000,000 gallons, valued at about $6,000,000.

In the latter part of 1879, after the short vintage of that year had been gathered in, it was found that most of the old stock had been exhausted. Suddenly the price of all kinds of wine went up, and the supply was barely sufficient to meet the demands of the market. This at once awakened a more general interest in wine growing; but there was a woful lack of knowledge on the part of the growers, and only a few acknowledged authorities to which to apply for information. Numerous newspaper articles appeared calling attention to the value of viticulture in that State, and expressing a desire for the formation of some State institution where such practical knowledge might be obtained as was necessary for the conduct of this important branch of agriculture. Under these circumstances the State legislature took the matter up, and in March, 1880, the State Board of Viticulture was created, and provided with funds to meet its necessary expenditures.

This board has been in existence for fifteen years, and under its direction all the standard literature in the English language on vine planting, vine cultivation, cellar management, distillation, and every branch of viniculture and viticulture, has been collected and published. The wealth of information to be found in French, German, and Italian works has all been drawn upon and compared with the actual experiences in California. Besides this, the board has been instrumental in procuring State laws promoting the making of pure wines, and in attending to matters of national legislation pertaining to the wine and brandy interests, and has exercised a fostering care over those who intended to plant vines, the cellarmen, wine makers, and wine shippers. Its cost to the State has been nominal compared with the returns that have resulted from its efforts.

At the present time wine making in California is one of the best paying agricultural industries, not only in that State, but in the United States. Wheat is depressed beyond example; barley has at present a comparatively low value; wool is scarcely worth the cost of shearing; the hop-fields, not only in California, but in New York, Oregon, and other producing States, are being sadly neglected on account of the great cost of picking; the fruit business at best is, particularly in California, one which depends largely on the failure of the Eastern crop to

insure good prices for Western producers; oranges are subject to every conceivable sort of fluctuation; while wine is returning a handsome profit to the producer.

There are two reasons for this. First, not only are the producers combined, but there is an era of good feeling existing among the shippers without parallel, perhaps, in the history of the California trade. The second reason is that there is no overproduction of wine. The shipments to the Eastern States, to Central America, Hawaii, Europe, and elsewhere, added to the California consumption of about 8,000,000 gallons, more than offset the production. No new vineyards are coming into bearing, while many of the old vineyards are being gradually killed by phylloxera. It will take at least six or eight years before the wine production of California can be materially increased, and for that time the wine industry will have to meet steadily increasing demands upon it, both in quality and quantity. There is, therefore, every prospect of an era of prosperity for at least ten years to come.

While I have thus far given a history of viticulture in California, with which I am particularly familiar, it must not be forgotten that there is in the Eastern States, particularly in New York, Ohio, Missouri, Illinois, Virginia, and Georgia, a most prosperous viticultural interest. The viticulturists east of the Rocky Mountains have had to contend with the difficulty of using native American vines and their hybrids for wine-producing grapes. Considering the drawbacks that they have encountered, their efforts have been in every way commendable, and their wines have a steady sale at remunerative prices.

Nicholas Longworth, already spoken of, was undoubtedly the leader in American viticulture. Until he began his efforts wine was practically unknown among Americans in the country districts, although a few bottles, having about as much value as gooseberry wines, were put up in many families, expressed from the grapes which were the progenitors of the Isabella, the Concord, or other common varieties. Longworth showed that really desirable wines could be produced upon American soil, with American growers and makers. Becoming rich early in life by fortunate purchases of land lying in the city of Cincinnati, he retired from the practice of law, his ostensible business, about the year 1825, to embark in horticultural pursuits. He first tried foreign grapes, but unsuccessfully, and then began experiments with native ones, with which he did not have the same difficulty. His first vineyard was a small one, but he gradually enlarged it, until he had 200 acres in grapes. His favorites were the Isabella and the Catawba, and from them he produced wine of a high marketable value. Since 1865 particular attention has been given to grape growing in many of the States in the East, there being a large demand for them for table use, and this incidentally has stimulated wine making. There are years in which the yield is so abundant that it hardly pays the grower to send the grapes to market; then more wine is made. But the bulk of the Eastern crop which is intended for wine is grown for that purpose. It is carefully handled, and by the best houses is kept three years in stock before any is sold.

The chief grape and wine growing district in the East is around Lake Keuka, in the western part of the State of New York. This is in the lake district, and the vineyards are from 500 to 800 feet above sea-level. The natural harshness of the climate is so modified by the existence of these large and deep bodies of water, fed by natural springs, and rarely freezing over, that grape culture can be better carried on there than in much of the region 500 miles south of them. Every one of these lakes, which lie at the end of the Appalachian chain of mountains, has many vineyards adjacent. Next to Lake Keuka come in importance Seneca Lake, Cayuga Lake, and Chautauqua Lake. Along the Hudson many grapes are grown. In an island in this river Underhill propagated the Iona grape, long regarded as the most valuable kind known. Ohio ranks with New York as a wine producer. The soil on Kelley's Island and Put-in-Bay, and around Cleveland and Sandusky, seems particularly adapted to it. Much comes from North Carolina, the Scuppernong being principally grown there; there are admirable wines in Missouri, and Virginia is now producing considerable quantities. No wines come from New England, although possibly they might be grown in the sunny valleys of Connecticut; but New Jersey is now making rapid strides in the way of good sound wines, fit to compare with good Burgundies. The skill of American wine makers has increased. The methods of handling the grapes, of caring for the newly expressed product, of improved cellarage, and of bottling, have all been learned with thoroughness. Although labor is dearer than in Europe, devices which save much cost have been introduced everywhere except to facilitate maturity. This depends entirely upon age, no artificial method being used to hasten that. Neither are there syrups introduced to give mellowness or tone. American champagnes are now largely used, and when properly

prepared are much esteemed. Much American wine is sold as foreign.

I am aware that there is a general impression in the East, particularly among some wine dealers who have heretofore handled only the European product, that California should produce but one distinctive variety of wine. On this point I wish to quote from a work recently published by the State Viticultural Commission, and written by Charles A. Wetmore:

"I have found generally that a notion—it is hardly fair to call it an opinion—prevails among the importers that there is, or should be, one distinctive type of California wines in general, and that we make some sort of a mistake in not producing a particularly distinctive type of California wine. To them the well-known characteristics of the vineyard districts of the Old World, such as Xeres in Portugal, Bordeaux, Burgundy, and the Rhine, appear to assume broad territorial significance individually, each being in importance equal to the opportunities of California. Small places in Europe occupy, in their minds, larger places than youthful California. They little appreciate the fact that the viticultural area, both in latitude and longitude, and in the value of climatic and soil conditions, of all the regions where grapes are grown successfully in Spain, Portugal, France, and Germany, is equally matched, both in extent and variety, on the Pacific coast. One might as well speak of the one typical wine of all those countries of Europe as to think of one wine representative of this coast.

"Few realize that the western coast of North America is practically the counterpart of the western coast of Europe, with Great Britain attached to the Continent. Every condition of soil and climate is here reproduced to compare with Xeres, Malaga, the Mediterranean coast of France, the slopes of the Alps, the valleys of the Rhine and Rhone, and the humid climates on each side of the British Channel. In the variations of practical possibilities in viticulture, every distinction known to the west of Europe, from Gibraltar and Nice to Scotland and the Netherlands, is found on this coast from Lower California to British Columbia. Our Algiers is inland in Sonora and Arizona, and our Russian Siberia is between the Rocky Mountains and the Sierra Nevada. To the average New York mind, however, both Los Angeles and Shasta appear to be suburbs of San Francisco, and as nearly related as Xeres and Malaga, or as the Medoc and Sauterne districts, while, in fact, they are as far apart as Xeres and Burgundy.

"To those who do not comprehend this coast let me say that every known viticultural condition of Europe that has been observed from the Rhine to the Mediterranean coast, and even across on the northern borders of Africa and eastward toward Palestine, can be found here in the territory from the Columbia River to the Gulf of California and eastward into Arizona. Every known variety of European wine-grapes finds somewhere here its natural home, and somewhere a place where it cannot be successfully cultivated. In some places none, in others few, and in others many, just as in Europe, are found to prosper. Many mistakes in the attempts to transplant and adapt have been made, and equally many in experimentation with European methods ill suited to locality.

"Our experiences and present conditions are similar to what might have been expected if, during a single generation, an enterprising people had found western Europe unpopulated, and had attempted, with one common purpose, to establish viticulture from the Mediterranean to the Rhine from one common nursery of all vines, and without such knowledge of the local peculiarities as has been, in fact, the growth of generations. Under such a possibility we might have had Spaniards cultivating the Palomino in the Medoc, Frenchmen trying the Medoc in Xeres, Germans essaying the Riesling in Languedoc, and Portuguese worshiping port on the Rhine, with numerous admixtures of all kinds of efforts in all places. The present condition of California viticulture is not much different from such a supposed condition in Europe, with the exception that our producers are far more intelligent and better informed as to their mistakes and the means of remedying them than European vintners generally are as to the causes of any of their present successes.

"I shall show, however, that progress and improvement in given lines of perfection are not entirely subject to the will of producers, even if natural conditions and knowledge are present. The producer who exports is governed by the will of distant markets, and California, so far as even the Atlantic States are concerned, is yet an exporter, aided only by a very limited consumption locally. Even France produces one kind of claret for England and another for the Argentine Republic; one kind of champagne for Russia and another for America; one kind of Burgundy for foreigners and another for Paris; and everywhere in her own territory is satisfied with her local wines of every kind and character, without recourse to foreign delicacies. Whenever foreigners—and I include New York as among the most foreign people we have to deal with—will become

satisfied with the best that each of our districts can produce without any attempt to imitate European styles, it will be time for them to complain that we do not produce typical California wines; but so long as the markets demand styles like favorite European brands, so long must California producers and dealers make attempts to please them, either with ignorantly devised methods and blends, or false labels; and so long as our Eastern Atlantic coast markets refuse to pay as much for equal quality, whether domestic or imported, they cannot expect producers to sacrifice quantity for quality in wine making to any practical extent."

The statistics of the production of wines in California from 1877 to 1895, and the exports out of the State by sea and rail for the corresponding years, are as follows:

PRODUCTION AND EXPORTS OF WINE FROM CALIFORNIA.

Year.	Production in Gallons.	Shipment out of State in Gallons.
1877	4,000,000	1,462,972
1878	5,000,000	1,812,159
1879	7,000,000	2,155,944
1880	10,200,000	2,487,353
1881	8,000,000	2,845,355
1882	9,000,000	2,810,735
1883	8,500,000	3,190,167
1884	10,000,000	3,524,099
1885	11,000,000	4,256,224
1886	18,000,000	5,192,223
1887	15,000,000	6,901,771
1888	17,000,000	7,235,994
1889	18,000,000	8,286,442
1890	18,000,000	9,092,082
1891	20,000,000	11,114,029
1892	20,000,000	11,117,752
1893	25,000,000	12,326,033
1894	15,000,000	14,031,405
1895	17,000,000	[1] 15,000,000

[1] Estimated.

The total consumption of the United States is about 36,000,000 to 38,000,000 gallons annually, which is supplied as follows:

	Gallons.
California (average)	20,000,000
Other States and Territories	14,000,000
Imported	4,000,000
Total	38,000.000

It may be now asked, What of the future? As for quantity, we can expect but little increase in California in the next six years. In quality we can expect much. Many choice producing sections are already well known. The best of foreign varieties have been tested in many locations, and their adaptability to different situations is thoroughly understood. Every year sees some improvement in our methods of viticulture, wine making, and cellar management. An industrious, intelligent, and experimenting class of citizens are bending their energies and thoughts to the production of the highest types. Lacking the experience that has come with centuries of work in Europe, possessing a new and rank soil at best, they are seeking to overcome every defect which may be found by an exacting connoisseur. Financially the prospects are excellent. Most of the old stocks of wine have been bought up and cleared out of the cellars. Markets have been developed in New York, New Orleans, Cincinnati, Chicago, Milwaukee, St. Louis, and all the leading cities of the country. There is scarcely a large city in which our wines have not found a market. The drug trade commends them and the brandies in the highest terms. At home we have the producers combined and standing for prices that will bring them a fair remuneration for their labor; we have the merchants receiving remunerative returns from their connections all over the country.

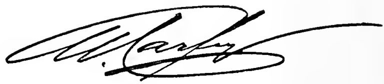
Of the needs of the viticultural industry there are but few things to say, though much might be said on each topic. We need a national pure wine law. We need some amendments to the internal-revenue laws which will, at least, place our producers upon an equality with the French brandy producers in the matter of blending and bottling brandy.

Concerning the necessity of a general national pure wine law, it can be said that there is a very general movement among all wine-producing countries for stricter regulations. The time has come when it should be generally recognized by the governments of the world that wine means fermented grape-juice, and does not mean a combination recently given by William Bailey Bryant in his "Nineteenth-Century Handbook on the Manufacture of Liquors, Wines, and Cordials without the Aid of Distillation," published by the Industrial Publishing Company, of Owensboro, Ky. His idea of an imitation of "red wine, cheap," is as follows:

"Water, one gallon; sulphuric acid, to the strength of weak vinegar; honey, one pint; powdered alum, one-half ounce; one sliced red beet and a half-pint strong tincture of logwood; one drop oil of wintergreen dissolved in a wineglassful of alcohol; one half of a grain of ambergris rubbed up in sugar; one pint tincture of grains of paradise. Any kind of bright sugar or syrup will answer in the place of the honey, and in less quantities. This wine, when prepared on a large scale, can be made at a very low price, as the honey is the only article

that is of value, the tincture of the grains of paradise being substituted for spirit; and any quantity of it can be prepared at the shortest notice. The coloring is kept prepared in barrels for use. When the beets are added, the mixture is allowed to stand for the coloring to become discharged from them for several days."

This book, I believe, is protected by the copyright laws of the United States. It is infamous, not alone that such a receipt should be allowed to be published, but that we have no national pure wine law to prevent the concoction of such a beverage, with sulphuric acid and water as a base. I say that we need a national wine law, because, under the Interstate Commerce Act, no State pure wine law can be made operative outside of the boundaries of that State, and, as far as I am aware, New York, Ohio, and California are the only States which have a wine law designed to prevent adulteration and the manufacture of imitation wines. One effort was made to secure such national legislation, but it was defeated, by what interests it is needless to mention; but the effort is to be resumed. Our second need, to secure the right to bottle and blend brandy in bond, will, I trust, be obtained at the coming session of Congress.



CHAPTER LIX

AMERICAN DISTILLERIES

THE extraordinary consumption of alcoholic liquors, and the extensive application of alcohol for all purposes, show it to be one of the most important substances produced by art. There is but one source of alcohol, its production arising from the fermentation of sugar or other saccharine matter obtained from plants containing either free sugar or starch convertible into sugar. It is a volatile, inflammable, colorless liquid, of penetrating odor and burning taste. In commerce, when made from maize or other grain, it is called grain-alcohol; from reindeer and Iceland moss, moss-alcohol; from potatoes and beets, root-alcohol; and from grapes, wine-alcohol.

The discovery of the art of distillation is attributed to the Arabian alchemists, the first mention of it occurring about the eleventh century; but it was undoubtedly known and practised for centuries before by the Chinese. Brandy was named the water of life, and one of the early alchemists, in his enthusiasm over the discovery, declares that "this admirable essence is an emanation from the Divinity; an element newly revealed to man, but hid from antiquity because the human race was then too young to need this beverage, destined to revive the energies of modern decrepitude." Distillation consists in converting a liquid into vapor in a closed vessel by means of heat, and then conveying the vapor into a cool vessel, where it is reconverted into liquid. The possibility of separating substances by vaporization is dependent upon the fact that very few substances are volatile at the same temperature. Thus while water boils at 212°, alcohol boils at 173°. Strictly speaking, the spirits are not produced by the act of distillation, but are the result of the previous act of fermentation, distillation merely separating the spirits from the mixture in which they already exist.

A little over a century ago, in 1791, the first internal-revenue tax on spirits was imposed, being nine cents a gallon on spirits manufactured from grain, it being estimated that at that time about 3,000,000 gallons were annually produced from domestic materials. This tax, light as it was, was strenuously resisted by the western counties of Pennsylvania, which rose in rebellion, and had to be suppressed by the militia of that State and adjacent ones. From 1802 to 1813 the internal-revenue tax was abolished, after which a tax on distillers was substituted for a tax per gallon. In 1816 the internal-revenue tax was reduced one half, and abolished entirely in 1818, remaining non-existent until 1862, in which year, being pressed for money to carry on the war against the Southern Confederacy, the nation found a prolific source of revenue in the taxation of spirits. The following has been the rate of taxation under the different statutes from 1862 to the present: July 1, 1862, the tax was twenty cents per gallon; March 7, 1864, it was made sixty cents; June 30, 1864, it was increased to $1.50; December 22, 1864, it was further increased to $2; July 20, 1868, it was reduced to fifty cents; June 6, 1872, it was changed to seventy cents; and on March 3, 1875, it was fixed at ninety cents, where it remained until August 28, 1894, when it was raised to the present rate of $1.10. In 1874 the revenue derived from spirits from all kinds of materials, including fruits, was about $43,000,000, of which $2,000,000 was from spirits manufactured from fruits. This was $2,000,000 in excess of the previous year. The total number of gallons produced during 1874 was about 69,500,000. The immense revenue derived by the government from distilled spirits is shown by the fact that during the last ten years it has aggregated about $1,000,000,000.

The progress made in the distilling business during the past century has probably been greater than in almost any other line of manufacture, all the latest achievements in science having been used to bring about such a result. At the dawn of the present century distilling was chiefly conducted by farmers, who made the crudest product in the crudest way.

A small kettle and a worm placed alongside his log cabin were almost as essential a part of the farmer's household equipment as a flail for his grain or a plow for his lands. In nearly every family liquor was a daily article of consumption, and the brown jug an indispensable adjunct to labor on every occasion. No commerce was conducted in alcoholic liquors in farming regions, each man creating his own supply. When one glances at the present immense business, with its distillery plants, many of which are palatial in their appointments, and some having a daily mashing capacity of 5000 bushels, the progress that has been made appears simply amazing.

The first product that reached the dignity of a place in commerce was so-called rectified whisky. It was the crude high wine after it had passed through a layer of charcoal, which largely extracted the fusel-oil and made a product ready for sale. To this were frequently added flavoring extracts, the compound then being put into heavily charred barrels, and a little sugar coloring added to smooth over its rankness and fieriness. Thus prepared, it was distributed among consumers, and some brands won for themselves a considerable demand. Following this process a redistilling apparatus was invented, by means of which the fusel-oil was more thoroughly extracted from the spirits. To make it more palatable a certain proportion of old-fashioned Bourbon from Kentucky, or rye from Pennsylvania or Maryland, was added to give bouquet, flavor, and the appearance of genuine whisky. This class of goods became known as redistilled whiskies, and the proportion of these which were sold in commerce as against the genuine whiskies of Kentucky and Pennsylvania was fifteen to one. In fact, the genuine goods made in Kentucky were used by dealers mainly for flavoring these so-called redistilled whiskies. It may be well for me at this point to define Bourbon whisky. The name now has a very wide significance. Originally it was whisky distilled from Indian corn or rye in Bourbon County, Kentucky. As its fame spread, countless imitations sprang up, so that today Bourbon whisky may be said to be whisky distilled from corn or rye after the manner in which it is made in Bourbon County. The yield of Bourbon whisky was then about three gallons to the bushel. It was heavy in body and flavor, qualities which made it very valuable in compounding; but it took many years of maturing to neutralize the fusel and other essential oils by the action of the atmosphere. The process of improvement was slow, and the trade recognized the fact that whiskies required at least three years or more to attain full maturity and become ready for consumption. At this stage the science of mashing was greatly improved, increasing the yield and lessening the cost of production. This had the effect of popularizing Kentucky Bourbons among the masses, and instead of being employed so largely for compounding purposes they came into use on a larger scale as a beverage. It also became patent to distillers and dealers that a larger yield did not injure the quality, but, on the contrary, made the whisky finer, as it contained less oils when made in quantity, and did not require so much time to develop its highest maturity. The pressure of competition has since induced some distillers of standing to sacrifice quality for quantity, and they have resorted to artificial means to produce the appearance of development. The whisky which has given Kentucky its reputation is that known as sour mash, and there are a few distilling firms who are so jealous of their reputation that they continue to distil only genuine sour mash, yield being a secondary consideration. To attain a fine bouquet, with its accompanying flavor and body, they eschew all artificial means of forcing development, recognizing as an undisputed fact that the atmosphere is the only chemist that can bring about such results. These firms constitute the bulwark which maintains the reputation of Kentucky whiskies. The larger number of the distillers look merely to the production of a deteriorated cheap grade, and the demoralization has taken such deep root that it is claimed by some producers that a year is all the time that is necessary to fit whiskies for consumption. While the production of cheap grades has lowered the standard of Kentuckies, it has diffused the taste for them among the masses, causing the dealers to substitute them for redistilled whiskies or so-called "domestics," which are but imitations of the genuine article. The present consumption of whiskies of all grades made in Kentucky is estimated at about 25,000,000 gallons per annum. The stocks remaining in bond of the product of the past four years are 83,000,000 gallons. Of rye whiskies, which are mainly produced in Pennsylvania, Maryland, and West Virginia, there were remaining in bond of the past four years' production as follows: Pennsylvania, 23,953,000 gallons; Maryland, 8,838,000 gallons; and West Virginia, 1,073,000 gallons; to which may be added Tennessee, which makes straight wheat whisky, with stocks in bond of the last four years amounting to 1,194,000 gallons. This represents the stocks of so-called straight whiskies, although, as above stated, but a small proportion of Kentuckies can properly be so classified.

JAMES E. PEPPER.

The principal States in which ordinary spirits are produced are Illinois, with a production for the year ending June 30, 1895, of about 21,000,000 gallons, of which there are remaining in bond 6,300,000; Indiana, with a production for the same period of 7,000,000 gallons, having 2,800,000 gallons remaining in bond; and Ohio, with an output also of about 7,000,000 gallons, having 4,000,000 remaining in bond.

I have hitherto confined my remarks almost entirely to spirits distilled from grain, the product from fruits being comparatively unimportant. From its greater availability and its cheapness, grain is in general use; while from fruits, which have a perishable nature and are non-available during the greater part of the year, there is distilled only a limited supply of apple, peach, and grape brandy, the State of California producing more than half of the fruit brandy made in this country. The total revenue for spirits from fruits in 1894 was but $1,287,497. Molasses as a distiller's material yields nothing but rum. Of late, however, attempts have been made to produce pure spirits from that source, but, owing to the difficulty of eliminating the rum odor from the output, the experiment is problematical. There is a very small production of rum, which is principally confined to New England; and the cheapness of grain spirits has tended to reduce the rum product to continually smaller dimensions. It is mainly manufactured for export purposes, very little being used in this country, as straight whiskies have superseded the once popular beverage. It should be stated that common spirits require no aging, being ready for manufacturing purposes or for compounding the day that they come from the still, and they never improve. In most cases, after having been doctored up to produce the appearance of genuineness, they are palmed off as true whisky under some euphonious title, and frequently they are audaciously placed on the market masquerading as sour mash.

In a review of American distilleries it is necessary that I should dwell for a moment upon the distilled spirits consumed in the arts, manufactures, and medicine in this country. Of these alcohol and cologne spirit take the lead, although high wines, whisky, brandy, rum, and gin are also used. Pure alcohol cannot be obtained by ordinary distillation alone. The rectified spirit or alcohol of the pharmacopœias contains nine per cent. by weight of water in the United States, sixteen per cent. in Great Britain; proof-spirit or diluted alcohol, fifty-four and one half per cent. by weight of water in the United States, fifty-one per cent. in Great Britain. That alcohol is used in some localities as a beverage is undoubtedly true, and it is said that fully one half of the alcohol that finds its way to the Northwest is so consumed by Poles, Norwegians, Swedes, Finns, Hungarians, and Russians. It has been estimated that about fifteen barrels of alcohol are consumed as a beverage daily in New York City, but it is impossible to collect data upon which to found a reliable estimate on this point. The foreigners employed in the coal regions of Pennsylvania are drinkers of alcohol, and a considerable quantity is annually disposed of among them. A large percentage of the cost of pharmaceutical preparations arises from the distilled spirits used in their manufacture. Concerning the amount of alcohol alone consumed in the arts, manufactures, and medicine in the United States, the Secretary of the Treasury, in his annual report of December 2, 1889, estimated it at about 6,000,000 proof-gallons. Cologne spirit is used for many purposes for which alcohol would be unsuitable, and whisky, brandy, rum, and gin form the basis of many proprietary medicines and of tinctures and medicinal wines. The amount of distilled spirits consumed in the arts and manufactures has been estimated at fifteen per cent. of all distilled spirits consumed, which is equivalent in round numbers to 12,000,000 gallons. The returns in proof-gallons, for the entire United States, of the wholesale druggists and manufacturers, eleemosynary institutions, and retail apothecaries, are given in the following summary:

DISTILLED SPIRITS CONSUMED IN THE ARTS, ETC., IN 1889.

Returns Received from	Aggregate.	Alcohol.	Cologne Spirit.	High Wines.	Whisky.	Brandy.	Rum.	Gin.
Total	10,976,842	6,745,152	1,453,048	75,992	2,023,900	266,874	189,581	222,295
Manufacturers and wholesale druggists	7,966,640	5,425,791	1,334,033	54,737	879,282	100,482	87,378	84,937
Eleemosynary institutions	102,790	30,092	4,374	883	59,222	6,599	841	779
Retail apothecaries	2,907,412	1,289,269	114,641	20,372	1,085,396	159,793	101,362	136,579

The eleemosynary institutions here referred to are dispensaries, homes, asylums, and others of a similar character. The above table shows that the total quantity of distilled spirits consumed in the arts, manufactures, and medicine in the United States during the twelve months ending December 31, 1889, was 10,976,842 proof-gallons. The following table gives the returns in proof-gallons, by totals for States, of all forms of distilled spirits consumed or sold by manufacturers and wholesale druggists, eleemosynary institutions, and retail apothecaries combined.

The inherent repugnance to paying the heavy tax on alcoholic liquors imposed by the government has given rise to a large number of illicit distilleries throughout the country. Occasionally one of these secret stills is unearthed in the large cities, which indicates that there are always more or less of them in operation at the centers of population. In the mountain regions of the country, more particularly in the South, a large amount of distilled liquor is drunk that never has been recorded in the Internal Revenue Department, or paid a penny of taxation.

DISTILLED SPIRITS CONSUMED IN THE ARTS, ETC., IN 1889.

BY STATES AND TERRITORIES.

States and Territories.	Aggregate.	Alcohol.	Cologne Spirit.	High Wines.	Whisky.	Brandy.	Rum.	Gin.
The United States	10,976,842	6,745,152	1,453,048	75,992	2,023,900	226,874	189,581	222,295
Alabama	41,343	18,781	648	.....	19,961	714	237	1,002
Arizona	1,235	244	....	......	778	152	17	44
Arkansas	30,234	13,532	883	......	12,846	1,314	50	1,659
California	294,572	170,948	74,613	7,663	29,236	6,630	1,562	3,920
Colorado	33,409	12,942	117	146	14,961	2,992	520	1,731
Connecticut	234,510	138,011	9,644	7,222	42,437	7,531	12,147	17,518
Delaware	11,063	7,949	581	15	2,012	260	49	197
District of Columbia	25,920	8,870	3,410	237	10,033	1,442	793	1,135
Florida	9,737	5,795	849	153	2,238	481	70	151
Georgia	143,153	97,668	32,236	285	11,378	857	188	541
Idaho	3,030	101	15	15	2,028	546	66	259
Illinois	1,306,332	721,552	231,190	18,698	267,022	31,383	4,552	31,935
Indian Territory	41	....	....	......	20	16	......	5
Indiana	294,448	131,123	10,719	1,137	120,561	17,035	1,499	12,368
Iowa	189,962	98,354	6,525	101	74,206	5,431	898	4,447
Kansas	42,518	10,492	790	1,500	26,092	1,905	88	1,651
Kentucky	131,912	59,083	2,824	1,023	58,853	8,153	355	1,621
Louisiana	152,914	115,276	6,262	627	26,972	2,120	769	888
Maine	115,585	83,369	6,396	53	13,539	1,898	6,949	3,381
Maryland	243,951	187,209	28,154	1,983	20,096	2,039	2,718	1,752
Massachusetts	1,018,080	659,406	74,951	5,051	124,743	19,883	102,354	31,692
Michigan	494,839	356,449	20,133	117	89,688	14,513	8,258	10,651
Minnesota	183,096	125,899	13,583	216	33,794	6,268	692	2,653
Mississippi	16,231	5,493	150	......	9,852	352	48	336
Missouri	1,071,068	655,824	120,688	1,955	253,756	22,641	2,213	13,991
Montana	6,394	4,653	9	......	1,264	327	19	122
Nebraska	180,372	106,258	1,966	136	54,607	11,384	742	5,279
Nevada	2,118	248	....	84	1,222	299	59	206
New Hampshire	59,465	27,133	1,057	75	16,578	2,418	7,447	4,817
New Jersey	176,175	123,909	22,922	1,338	18,372	4,868	1,335	3,431
New Mexico	3,619	500	38	......	2,353	545	43	140
New York	1,760,343	1,107,696	366,164	18,386	197,551	29,581	16,727	24,238
North Carolina	14,661	4,841	81	......	7,987	1,302	264	186
North Dakota	6,272	2,758	188	75	2,485	486	100	180
Ohio	647,339	412,151	37,550	1,321	162,001	16,781	3,243	14,292
Oklahoma	43	43	....	.....	.....	......	......	....
Oregon	85,917	60,732	8,135	7	12,851	2,851	244	1,097
Pennsylvania	1,142,941	703,625	305,574	1,902	102,711	14,497	5,768	8,864
Rhode Island	133,065	101,848	1,968	225	14,269	2,185	7,734	4,836
South Carolina	22,510	15,591	1,083	853	4,445	334	21	183
South Dakota	5,422	2,179	267	3	2,349	357	68	199
Tennessee	221,981	128,434	32,375	36	54,164	5,343	150	1,479
Texas	101,455	51,994	8,302	2,101	33,660	3,528	75	1,795
Utah	25,058	8,736	7,913	9	5,038	2,593	234	535
Vermont	43,412	30,744	1,820	33	7,213	751	1,653	1,198
Virginia	37,903	26,986	2,448	78	7,414	537	411	29
Washington	10,874	2,406	258	37	5,774	1,622	211	566
West Virginia	32,361	11,929	431	753	16,400	1,708	28	1,112
Wisconsin	164,728	123,675	7,150	343	25,071	5,756	813	1,920
Wyoming	3,231	1,722	38	......	1,073	265	70	63

This criminal branch of the history of American distilling would make interesting reading on account of its picturesque character, but I can only allude to it here. For reasons that are obvious, no estimate worth having can be formed of the amount of distilled liquor in the United States that evades the government tax, but the figures would doubtless reach considerable magnitude.

The daily capacity of grain distilleries in operation February, 1895, was 85,237 bushels, equivalent to an output of 358,620 gallons; and in the previous month there was a daily output of 364,559 gallons. I select January and February as the season when distilling is in full operation. In August, 1895, there was a daily mashing capacity of 68,454 gallons. August is a month in which distillation is almost at a standstill.

It should be stated here that the official compilations as to the number of distilleries are apt to be misleading. A very small number of distilleries are practically turning out the entire output. Officially, it is stated that in February last Illinois had but 15 stills in operation, with a daily capacity of nearly 100,000 gallons; while North Carolina is credited with nearly 300 stills, with a daily capacity of but 3148 gallons. In other words, the number of stills in operation appears nominally very large, approaching 1000, while actually the bulk of the output is produced by less than a tithe of that number.

The number of fruit (apple, peach, and grape) distilleries registered and operated during the year ending June 30, 1894, was 3633, with an average daily capacity of not quite one gallon each. Of these North Carolina had 1115 stills, or nearly one third of the whole; Virginia had 1230, leaving outside of these two States but 1288 stills.

The average quantity of grain used in the production of spirits during the last ten years is about 22,000,000 bushels; in the year ending June 30, 1893, it reached 29,000,000 bushels, which produced 126,545,000 gallons. Fully half the grain used is corn.

An important collateral industry is the feeding of cattle and hogs on the distillery slops. During the year ending June 30, 1894, this industry showed the following results:

CATTLE FEED FROM DISTILLERIES.

	Pounds.	Number.
Number of cattle fed at regular grain distilleries		62,123
Increase in weight of cattle	14,449,516	
Average increase in weight	232	
Number of hogs fed		25,554
Increase in weight of hogs	1,901,748	
Average increase in weight	74	
Total increase in weight of cattle and hogs	16,351,264	

To this increase, Illinois contributed 8,000,000 pounds, or about one half.

The amount of spirits withdrawn from distillery warehouses for scientific purposes and for use in the arts in the United States is very small, but increasing. Thus in the year ending June 30, 1892, there were 39,400 gallons; in the following year, 54,552; and in the next year, ending June 30, 1894, the amount was about 70,000—an increase of 15,000 and 14,500 in each successive year. Of the withdrawals in 1892, 65,000 gallons were alcohol and 4500 neutral or cologne spirits, out of a total of 69,700 gallons.

The entire production of alcoholic spirits from grain in the United States for the last fiscal year, ending June 30, 1895, was 80,116,374 gallons; withdrawn tax-paid, 74,200,720; and remaining in bond, 138,351,894.

The tax paid to the Internal Revenue Department for the maintenance of the government from alcoholic liquors for the last fiscal year, ending June 30, 1895, was $79,862,627, or $5,396,674 less than the previous year.

When one compares these figures, reaching over 80,000,000 gallons, and the enormous revenue accruing to the benefit of the general taxpayers, with the petty production for private use by farmers a century back, the unexampled progress must be apparent without further comment. The spirit interest has interwoven itself with the life of the nation, so that it has become one of the most trustworthy sources of national income.

The necessity of increasing the revenue has fostered legislation favoring a higher tax, which unfortunately tends to bring among the masses inferior goods; for the higher the impost the lower the standard of quality must be in order to make up for the increase in cost. The purpose of every legislator should be to promote the public health and welfare by making it possible for producers to furnish a wholesome beverage, thoroughly matured, at the minimum cost. To tax it to death does not accomplish this object. It naturally forces the production of cheap imitations, which are made out of common spirit, and often sold the same day that they are made. That whisky requires several years' time for properly maturing is universally acknowledged. Those brands alone should be, in my opinion, allowed to be sold that can show natural aging.

In European countries alcoholic liquors, such as brandy, etc., are allowed to remain in bond until required by the trade for consumption. This plan always insures a large stock of matured goods in bond. There is no reason why our government should force the tax-payment at any given period.

In order to extend the trade into foreign countries, the privilege of bottling whiskies in bond, and reducing them to such proof as may be required for commercial purposes, should be extended to the distillers of this country, as it is in Canada, where the government, alive to the interest of its manufacturers, affixes a stamp to each bottle, thus certifying to the genuineness of the contents. This would infuse confidence and promote export trade, as well as afford an opportunity for our citizens to secure a genuine and wholesome beverage. The trade in Canadian whiskies has been steadily on the increase for years, owing to this privilege so wisely conferred by the Canadian government.

The inequality in the conditions affecting our distillers as contrasted with those of Canada may be better understood when it is remembered that at the last session of Congress our government increased the tax on our product from ninety cents to $1.10 per gallon, and lowered that on foreign spirits from $2.50 to $1.80, thus letting down the bars to those who already had superior protection from their own governments. This was not merely the special privilege of bottling in bond, but the ruling, in the case of the Canadian government, that forbade the importation of any whiskies from the United States unless in 100-gallon packages. It should be stated that our packages run about forty-five gallons, larger packages not being found practicable for aging purposes. This action of the Canadian government amounts to practical prohibition, and results exactly as was intended, for none of our whisky now finds its way into that country.

The history of the large combination of American distillers of alcoholic liquors is too recent and somewhat too complicated for me to dwell upon at this time. I have endeavored to show the enormous importance of the distilling industry not only to the government, but to the people of the United States, and my conclusions with reference to legislation on the subject of distilled spirits are arrived at with a sincere desire to foster and assist by intelligent means the progress of one of America's greatest industries. Marvelous as has been that progress during the century now closing, it is but reasonable to suppose that the record of the next hundred years of our history will be such as to reflect the greatest credit upon the intelligence and enterprise of American distillers.

Jas. E. Pepper

CHAPTER LX

THE BREWING INDUSTRY

BEFORE the use of written words the lips of our Aryan ancestors articulated a sound which expressed for them food and drink, and the source from which these things came. This source was the bearded barley of the Himalayas. The porridge and the bread of the Aryans, made from the first grain used for common food, were the crudest forms from which has sprung the brewing industry. It was not until the Sanskrit writers, in their earliest record of the living language, drew the distinction, that separate words were used to express barley, bread, and beer; and even now a euphonious ear will catch the similarity in these three words, which, though much changed from their Aryan prototypes, still have a musical resemblance which tells us of the kinship of the three. The story of beer is therefore as old as the story of humanity.

In the most remote antiquity the Egyptians brewed, as did the Assyrians, and later the Greeks and Romans; and from time immemorial the Teutonic race have been famous for their skill in the production of the beverage for which they praise to-day, in poem, prose, and story, in song and eulogy, the name of the very modern but acknowledged patron saint of brewing, Gambrinus. The word for beer has been preserved, as the art of brewing has been developed, by the Teutons. The Egyptians called beer *zythum*, and the Greeks and Romans, *cerevisia;* but the word "beer" in some form has always been used to express to the Teutonic mind the ancestral beverage.

While the written history of brewing begins with Egypt, and the development of the art of brewing should properly be accredited to the Teutons, to America must be credited the attainment of scientific perfection in the craft, which, like mathematics, has become in the United States practically a finished science. When the Pilgrim Fathers landed on Plymouth Rock they brought with them from England, in addition to the fiery potables they were wont to drink,—"and not a man afraid,"—some of the sturdy brew of "merrie England," and also a knowledge of the brewer's craft, which they soon turned to practical use in the land of their adoption.

The Dutch settlers of New Amsterdam, with their long clay pipes puffing clouds of blue smoke, were wont to sip from generous tankards the beer of the Netherlands, and crack their jokes around the tavern table, the while they grew fat, sleek, and jolly under the gentle influence of their beneficent national beverage. Good William Penn found solace in the brew made under his direction for his young, peaceful, but aspiring colony; and farther south, in old Virginia, many were the happy gatherings where harmony prevailed, and memories of their old home far across the sea rose through their companionable chat, like the foam upon the treasured musty ale.

In New England, where the stronger spirits most prevailed, our good forefathers passed a law granting immunity from taxes and a prize in money to that energetic brewer who should brew in a single year more than 500 barrels of honest beer; for, said they, not only does this peaceful beverage add to the prosperity of the farmer by giving him a market for his grain, but, by supplying to our worthy citizens a beverage of much milder form, adds much to the temperance and good order of Massachusetts Colony. So peacefully, with full approval, and yet with growth most unfortunately slow, an infant industry was formed, which in 1795 produced upward of 2,000,000 gallons.

Legislative enactment, in the varying application of intelligence and ignorance, liberality and fanaticism, has, since the days of the Egyptians, hampered or caused the expansion of the brewing industry. While, prior to 1795, it does not appear that legislation adverse to the brewing industry was enacted, legislation favorable to the cheaper distribution of distilled liquors brought the more potent beverages

to the front, and held in check the brewing industry, which would otherwise have proved itself more powerful in promoting temperance than any organized legislative effort. During the administration of Washington, Congress, in considering the very first federal-revenue law, was impelled by consideration of public morality to take cognizance of the importance of fostering the brewing industry. But opposition from various quarters arose. In 1789 Madison expressed the hope that the brewing industry would strike deep root in every State in the Union, and Thomas Jefferson gave expression to the opinion that "no nation is sober where the dearness of fermented drinks substitutes ardent spirits as a common beverage."

In 1810 the domestic production of malt liquors amounted to 5,754,735 gallons. There were only 129 breweries in this country, most of them producing ale and porter exclusively. In 1847 the increasing German immigration brought into America not only a demand for their favorite beverage, lager-beer, which gave a new impetus to the trade, but also a practical knowledge of the craft; and lager-beer breweries began to spring into existence wherever a sufficient number of Germans had settled to make these little local establishments possible. Americans sniffed suspiciously at this form of beer, which was new to them, and allowed difference in race to prejudice them against what was destined to be their national beverage. Owing to the greater popularity of lager-beer, the production of ale and porter at the present time does not exceed 1,000,000 barrels.

The modern reformer, when confronted by the indisputable fact that the Germans are one of the most temperate of nations, if he be somewhat fanatical in his prejudices, blindly closes his eyes, and in his attack upon what he is pleased to call the moral wrong of the production, sale, and use of intoxicating beverages, forgets to discriminate, and thereby misses in many instances the true solution of the whole question, which is such legislation as will make reasonably accessible the mildest of the great family of beverages, and hold under proper restrictions those which are not beneficial in their effects. Long before German immigration had assumed any noteworthy proportions the wisest and most patriotic statesmen of our country were so alarmed at the increased use of fiery intoxicants that they would have resorted to any legitimate means to force breweries into existence. Therefore, between these conflicting elements, it was a constant struggle for existence with the brewing industry up to 1862.

It remained for the exigencies of the great Civil War to bring forth such excise measures as should put the lighter beverages prominently to the front. Heroic measures were taken to raise the revenue and save the government from impending disruption. The internal-revenue laws came into existence. These threw the burden of taxation heavily upon ardent spirits. The passage of these laws in July, 1862, was practically the beginning of the development of the present vast brewing industry. It was like the breath of new life, and the extraordinary advancement of brewing from that day to this has been a surprise and wonder to all who have watched its history.

It was in 1862 that the Brewers' Association was formed. A moving cause in its organization was a desire for self-protection, and yet the fundamental principle which brought the American brewers together was patriotic, for they associated for the purpose of jointly aiding the government in perfecting the revenue laws relating to malt liquors, enforcing by their moral influence the collection of the revenue without discrimination, and of securing themselves by organization against unjust treatment. To its credit be it said that the Brewers' Association has never lost sight of its fundamental purpose. Born in the throes of the great struggle for national unity, it has served the government faithfully and well, and, instead of criticism and opposition, it has evinced sympathy and coöperation in the efforts of the government to establish proper internal-revenue laws, and has willingly acquiesced in the payment of this species of taxation.

The War of the Rebellion also brought about a remarkable revulsion of feeling in regard to our foreign population and their customs, especially as to the Germans and beer drinking. When the war put the patriotism of the people to a crucial test the Germans were found among the first to rush to arms in defense of our country. Old prejudices vanished before the bond of sympathy soon warmly established, like mist before the sun. This brotherhood established by the Rebellion has never died out, but has constantly grown stronger, and has cemented us together as one race. We have contributed to one another many of our habits and peculiarities, many of our customs. The habit of drinking fermented beverages, which was a characteristic of the Germans, is probably the highest contribution to temperance and good order which has come to us from any foreign nation.

The production of beer from the year 1863, expressed in barrels, is as follows:

BEER PRODUCTION FROM 1863.

Year.	Barrels.	Year.	Barrels.
1863	2,006,625	1880	12,800,900
1864	3,141,381	1881	14,125,466
1865	3,657,181	1882	16,616,364
1866	5,115,140	1883	17,349,424
1867	6,207,402	1884	18,856,826
1868	6,146,663	1885	19,216,630
1869	6,342,055	1886	20,289,029
1870	6,574,617	1887	22,460,345
1871	7,740,260	1888	24,569,682
1872	8,659,427	1889	25,098,765
1873	9,633,323	1890	26,820,953
1874	9,600,897	1891	30,021,079
1875	9,452,697	1892	31,474,519
1876	9,902,352	1893	33,876,466
1877	9,810,060	1894	33,789,984
1878	10,181,158	1895	33,237,648
1879	10,589,937		

SALES OF BEER IN THE PRINCIPAL CITIES OF THE UNITED STATES, FOR THE YEAR ENDING MAY 1, 1895.

Cities.	Barrels.
Albany	364,694
Baltimore	591,557
Boston	1,025,948
Brooklyn	1,941,395
Buffalo	618,743
Chicago	2,687,947
Cincinnati	1,145,806
Cleveland	429,665
Detroit	365,215
Louisville	212,695
Milwaukee	2,208,654
Newark	1,209,058
New York	4,732,300
Philadelphia	1,852,106
Pittsburg	435,880
Rochester	554,815
San Francisco	500,183
St. Louis	1,943,084
Syracuse	252,202
Toledo	245,609
Troy	230,539

These statistics, showing a development in the last century from 2,000,000 gallons in 1795 to 1,030,368,088 gallons in the year 1895, speak more eloquently of the marvelous advance than glowing language. There are now 2200 brewing establishments, by far the greater number making the lager-beer of the Germans. They range in magnitude from the little home brewery of some German garden to the gigantic business enterprise with an annual output exceeding 1,000,000 barrels. In the earlier years brewing was carried on exclusively for local markets. Within the last thirty years, however, the shipment of beer in barrels from one point to another began, and now train-loads of the delectable, foam-capped beverage leave the great shipping cities daily. The capital invested in brewing in the United States is about $400,000,000. The value of the annual output of the industry is $200,000,000. It contributes to the support of the United States government, in internal-revenue taxes alone, over $33,000,000. The local taxes paid by it aggregate over $3,000,000 more. The development of the bottling of beer from nothing to a business which, in one brewery alone, amounts to over 42,000,000 bottles annually—mostly quarts—is a remarkable evidence of growth. Over 50,000 men are directly engaged in the brewing of beer in the United States.

These material manifestations of progress by the mere aggregation of figures are based upon a deeper and broader advance in the application of science to the art of brewing. The establishment of brewers' schools, where theory and practice could be brought into constant association, where experiments could be conducted, and where a thorough training could be given to brewers' sons who, with an inherited tendency to skill in the art of their forefathers, desired to equip themselves with a higher knowledge of the craft, has brought into the field of competition a skill in the manipulation of the various processes of the brewing industry which has made possible a greater advance in the art of brewing since the year 1870 than had occurred from the time of Queen Elizabeth and the days of Shakespeare's Falstaff.

Only thirty years ago the principles governing the production of beer were, as we see, essentially unchanged. The interval of seventy years from 1795 had brought no noticeably valuable advances in the art. While it is true that chemistry, physiology, and botany, and, above all, the science of mechanics, passed through great development during the first half-century, it apparently meant nothing for the art of brewing save a thorough and necessary preparation of the various factors which were to be the foundation on which should rest the subsequent extraordinary progress—a progress destined to make brewing one of the most delicately scientific arts of manufacture. During the last quarter of a century, however, the brewing industry, taking advantage of every development of modern analytical investigation and mechanical advance, has been subject to radical improvements in all directions. It is especially indebted to Pasteur, Naegeli, Hansen, Lintner, and Delbrueck, who have contributed immeasurably to the creation of the higher art of brewing.

The dawn of an unsuspected and unparalleled line of improvement in the science of brewing, considered especially with reference to the physiology of fermentation, appeared with the labors of Pasteur, published to the world in his "Études sur la Bière" in 1876, in Paris, and later with those of Hansen at Copenhagen, concerning the physiology of the

organisms of fermentation. From time immemorial beer had been known as a perishable product, but the causes leading to its spoiling were shrouded in deep mystery. Pasteur proved that the diseases of beer might be traced to the growth of injurious organisms, especially bacteria, and indicated the ways and means of preventing these diseases through the application of a rational process of wort cooling and fermentation. Hansen advanced an important step further by proving that the brewer's yeast might become, by contact, under given circumstances, with similar organisms closely resembling it, more injurious than bacteria. He crowned his labors by developing and introducing a process of cultivating yeast, in absolute purity and in large quantities, from a single germ, thereby also preventing the introduction of wild yeast into the beer. These improvements were soon applied upon a large scale in the leading breweries of the United States, and brought about material changes in their practical operation. After the principle of preventing infection had once been proclaimed, the old-fashioned open cooler was replaced by a suitable closed apparatus, often ingeniously constructed, which came up to the highest requirements of the new science. Closely connected with this was the use of filtered air, rendered germ-free, and of sterilized water, so that to-day the product of the brewer's art, in its highest and ideal perfection, is absolutely protected against infection. From the moment it leaves the brew-kettle, passes over the coolers, and through the process of fermenting and lagering, and up to the moment when it is served as a refreshing and perfect beverage, perhaps thousands of miles from the place of its production, it is protected by constant, accurate, and effective scientific safeguards.

Physiology and theoretical chemistry, hand in hand, have made brilliant progress in the science of brewing. The most complicated processes in the malting of barley, in mashing, and also in fermentation have been thoroughly explored and have come to be perfectly understood during the last few decades, and have laid solid foundations for the activity of the maltster and the brewer. An important place in this connection must be assigned to an invention which has brought about more radical changes in the brewery than any other, and which alone has made possible the introduction of numerous other improvements and innovations. This invention is the ice-machine and the application of artificial refrigeration upon a larger scale. Hardly twenty-five years ago the imperfect ice-machine of Carré, a Frenchman, was considered a curiosity, while to-day the model machines of Linde and De la Vergne are common property of all the brewers.

Americans may now justly claim to produce in the United States, not only the best beer, but, as is acknowledged by European authorities, the most durable beer, in the world. It is a peculiar, although incontrovertible fact, that the latest scientific theories of brewing, credit for which belongs to European investigators, have always found the most rapid and complete application and introduction in practice in this country. Professor Delbrueck, of Berlin, and Professor Schwackhoefer, of Vienna, who were sent to America in 1893 by their respective governments as authorities upon brewing, for the purpose of studying American breweries, were agreed in acknowledging this fact, and in their official reports did honor to the American brewing industry as they had found it. We have particular reason to be proud of the fact that a special process of fermentation which has been in use in this country for years has recently been proved by Professor Delbrueck to be the most rational process, judged from a scientific standpoint. This shows clearly to what an extent the theories of European investigators have been practically applied in this country before they were ever practically adopted abroad.

It would be going too far to recount all the different improvements to which the science of brewing has led us within the last few years. But there is one innovation that deserves to be mentioned, which has attracted attention of late, and which had its origin in our own country. This is the collection and utilization in its purity of the carbonic-acid gas formed during the process of fermentation. This process makes it possible to abandon the former "kraeusen" process, the old-fashioned method of carbonating. The finished product may now be charged with the finest natural carbonic-acid gas. This collection of the by-product of fermentation produces such a superabundance of carbonic-acid gas that it may readily be liquefied, and is destined to crowd out of the market all other products of its kind. As Americans we have particular reason to be proud of this achievement, because the solution of the problem had been attempted in vain by European authorities for many years.

During a trip covering the year just passed it has been the pleasure of the writer to satisfy his curiosity, as never before, by a careful investigation of the methods of foreign brewers, and, by taking the American method of perfect brewing as a standard, to reach certain conclusions which, as an American, he is proud to hold: first, that while the deep, analyt-

Fred. Pabst.

ical, concentrated, and tireless mind of foreign, and especially German, scientists may, by more painstaking and patient application, have attained for the world a better knowledge of the fundamental theories on which success in the art of brewing should rest, it took the broader grasp, the more nimble and daring intelligence, of the American mind, and the tremendous energy of American enterprise, to put these theories into practical operation; second, there is an overwhelming difference in advanced methods, to the credit of the American; third, the American schools of brewing are now in the very van of scientific progress, and, even if equaled, are certainly not surpassed in the higher technical instruction which they give.

As beer is to become, if it is not already, the national beverage of the United States, and as increasing skill in the art will contribute immeasurably to the good health and temperance of the race, it is indeed a source of congratulation that the brewers of America are fully alive to the responsibility which rests upon them, and that they realize in the deepest, broadest sense that their own prosperity, their own advancement, and their own standing in the community depend upon the development of their craft to the highest ideal of perfection.

Fred Pabst.

CHAPTER LXI

AMERICAN TOBACCO FACTORIES

IT seems almost incredible that tobacco, the dried product of a common herb, possessing the properties of a narcotic stimulant, and in no way necessary for man's sustenance, should have from its first introduction progressively increased in consumption wherever used throughout the habitable globe; that, despite the opposition of the combined powers of the church, the state, and the moralist to its use, its consumers being the subject of ridicule, persecution, and even mutilation, and itself an object of universal taxation, it furnishes at the present time not only one of the largest staples of commerce, but provides as well one of the leading manufacturing industries of mankind.

The use of tobacco being nowhere mentioned prior to the discovery of America, at which time the species *Nicotiana Tabacum*, now almost universally grown, was being extensively cultivated by the natives, it need excite little surprise, when its universal use is considered, that the tobacco industry has been inseparably connected with the history, growth, and prosperity of our country from its earliest settlement to the present time, or that the few thousand pounds grown and exported by John Rolfe, of the colony of Virginia, in 1612, should have increased to the present enormous yield of 500,000,000 pounds per annum, grown upon an area of 693,000 acres, by 205,000 planters. About one half of this product is consumed at home, and the remainder exported, mainly to Great Britain, France, Germany, Spain, and Italy.

The high prices which tobacco commanded upon its introduction into England in 1586 greatly stimulated its production in the colonies. The foundation, however, for the enormous tobacco industry of our country was laid through an event which afterward proved a most potent factor in the destiny of the American Republic. In August, 1619, the captain of a Dutch man-of-war sold to the planters upon the James River, Virginia, twenty negroes (African captives), the first slaves introduced into the territory of the American colonies. Within the next one hundred and fifty years the slaves in the colonies numbered over 290,000, scattered from New England to Georgia; and under the stimulus of this class of labor the annual exports alone of the staple exceeded 70,000,000 pounds.

In Virginia, as early as 1633, tobacco-inspection warehouses were established, to which all tobacco grown for sale was required by law to be brought before the last day of each year, for examination by colonial inspectors appointed for that purpose, "who shall cause all the badd and ill-conditioned tobacco instantlie to be burnt, and the planter thereof to be disabled further from plantinge any more of that commodite of tobacco." These inspectors, being sworn and placed under heavy bonds, were authorized to issue formal receipts for accepted tobacco. Such receipts by law became a legal tender, and under the title of "tobacco notes" were for over a century the medium of domestic and foreign exchange, being receivable for all debts, public and private, at a value per pound annually fixed by the Assembly, the price being based upon quality, supply, and demand. The price was therefore uniform, whether the tobacco was raised for sale or for use as a legalized circulating medium in barter. The penalty for forging these certificates, as well as against inspectors who issued them fraudulently, was death.

During the year 1633 the barter price of tobacco was fixed at ninepence a pound; but in 1639 so great was the over-production and disregard of quality that its cultivation was restricted, and all debts ordered satisfied in tobacco at threepence a pound. Indiscriminate planting was stopped by the governor and council of Virginia, with the consent of the Assembly, and each planter restricted to 100 plants, on each of which should be left but

nine leaves. As late as 1732 tobacco was made a legal tender in Maryland, on a basis of value of one penny a pound.

A marked change is shown in the distribution of the tobacco crops of the United States during the past one hundred and fifty years. In 1750 tobacco cultivation was confined almost entirely to Virginia and Maryland. In 1840 the product of the eight leading producing States, expressed in millions of pounds, was: Virginia, 75; Kentucky, 55; Tennessee, 29; Maryland, 24; North Carolina, 16; Missouri, 9; Ohio, 5; and Indiana, 2; while in 1890 the product was: Virginia, 49; Kentucky, 222; Tennessee, 36; Maryland, 12; North Carolina, 36; Missouri, 9; Ohio, 38; and Indiana, 7—the production of Kentucky alone being 33,000,000 pounds in excess of the other seven States combined. Retarded for a time by the War of the Revolution, and again, later, by the Civil War, the cultivation of tobacco has constantly increased, until at the present time its production is the largest in its history. Its cultivation has always been confined to the belt where it originated—a tract of about 600 miles in length by 300 in breadth, comprising portions of the States of Maryland, Virginia, and Kentucky, the northerly counties of North Carolina, the Cumberland Valley in Tennessee, the Miami Valley and Ohio River counties in Ohio, and small areas in Missouri, Indiana, Illinois, and Mississippi. These districts produce nearly all of the manufacturing and export tobaccos of the United States, exclusive of the tobacco grown for cigars, which is a more northerly product.

The manufacture of tobacco and snuff is, so far as known, coeval with its cultivation. The practice of snuff taking was observed by sailors sent by Columbus to the isle of Cuba on his second voyage in 1494. In 1502 Spanish explorers on the South American coast noted the habit of tobacco chewing among the natives, and a few years later European explorers crossing the North American continent observed the universal custom of pipe smoking among the Indians, both as a symbolical and a social custom. Small factories were early started throughout the colonies to supply, in some form convenient for handling, those localities where either tobacco was not grown or the larger proportion of settlers were engaged in other pursuits.

The earliest form of general use, by which each individual became, as it were, his own manufacturer, was the rubbing and breaking up of tobacco in the hand for pipe smoking. As the outside demand became greater the dried tobacco was rubbed by the manufacturer through sieves of various meshes to the inch, to suit the convenience and taste of consumers. This procedure, with improved methods of handling, is still the process by which granulated smoking-tobacco is made. A machine for making cut smoking-tobacco was described in 1732 as located in a Virginia manufactory, the output of which was 54,000 pounds per annum. In 1765 the manufacture of snuff was in comparatively few hands, the product being ground entirely by hand through the use of iron mortars and pestles. Before the adoption of the Constitution the leading snuff industries of the country, which were located at New York, Boston, and Philadelphia, had attained considerable proportions.

About the year 1760 the entire tobacco industry was revolutionized by the introduction of water-power. This in turn being later replaced by steam resulted in the industry becoming centralized in the hands of a few manufacturers. As late as 1794, under a law for the encouragement of manufacturers, State aid was conjoined with private capital in New York for the construction of a combination mill near Albany, to manufacture and grind, roll and cut tobacco, Scotch and rappee snuff, mustard, chocolate, starch, hair-powder, split pease, and hulled barley. In this mill all the operations, even to the spinning of tobacco, were performed by water-power, the tobacco-mill having a capacity of 100,000 pounds per annum. This plant, at that time the most extensive and perfect of its kind in the country, well illustrates the advance of the tobacco industry during the past one hundred years.

The subdivisions of the industry at the present time maintain about 800 factories, of various capacities, located in all sections of the Union, at least 4 of which are snuff-mills, each producing annually upward of 2,000,000 pounds of snuff; 10 plug-tobacco factories, each with an annual output ranging from 5,000,000 to 20,000,000 pounds; 15 smoking-tobacco factories, whose annual production varies from 1,000,000 to 5,000,000 pounds each; and 5 factories in each of which are annually manufactured from 1,000,000 to 4,000,000 pounds of fine-cut chewing-tobacco. In all there are 50 factories manufacturing over 1,000,000 pounds each, and nearly 200 factories producing over 100,000 and less than 1,000,000 pounds each.

Manufactured tobacco and snuff were early the objects of internal taxation by the general government. Alexander Hamilton, Secretary of the Treasury, in 1790, recommended a tax of ten cents per pound on snuff, and six cents on other kinds of

manufactured tobacco, as likely to produce annually from $90,000 to $100,000, computing the quantity of these articles manufactured as exceeding 1,500,000 pounds, and reasoning that "this, being an absolute superfluity, is the fairest object of revenue that can be imagined." Acting upon this recommendation, an act was passed by Congress in 1794, under which snuff and sugar were combined in one bill as objects of internal-revenue taxation, the tax on the former being eight cents and the latter two cents per pound, the import duty being respectively fixed at twelve cents and four cents, and the drawback or allowance for export the same as amount of internal tax paid.

In 1795 the internal duty was taken from snuff and laid on snuff-mills, for the reason that "the tax was difficult of collection and liable to great evasion"; and "it appearing that a snuff-mill works about half the year,—that is, 156 working-days,—yielding per mortar an average of forty-five pounds of snuff per day, it follows that $561.66 per mortar per annum, as the equivalent of eight cents per pound, would yield a similar revenue." The tax was therefore fixed as follows: every mortar worked by water-power, $560; every pair of millstones, $560; every pestle other than that worked by hand, $140; every hand-pestle, $112; and every mill in which snuff is manufactured by stampers or grinders, $2240—providing at the same time for a drawback of six cents on each pound exported. The internal-revenue tax on snuff collected for the six months ending March 31, 1795, at the rate of eight cents per pound, amounted to $3887.84½, while for the six months ending September 30, 1795, including the mill tax, the collections increased to $11,662, and for the year ending September 30, 1796, the collections, under the law taxing the snuff-mill, etc., aggregated $17,124.80. This last system of taxation caused great dissatisfaction among manufacturers, since the duty was paid on the plant regardless of the quantity manufactured; and as the government paid out for drawbacks to some manufacturers an amount exceeding that received for revenue, the inequality of the operations of this law was so apparent that the act was suspended in 1796, and again by subsequent sessions of Congress until 1800, when it was repealed.

During the past thirty-two years the tax on tobacco has proved a source of enormous revenue to the government. During this period the contribution through taxation of the tobacco industry to the support of the general government approximates close to $1,000,000,000, being nearly one quarter of the receipts from all sources of internal revenue between July, 1863, and July, 1895, and nearly ten per cent. of the entire income of the government from customs, internal-revenue and direct taxes, sales of lands, premiums on bonds, and other miscellaneous sources during the same period of time.

By the United States internal-revenue laws the tobacco industries were divided for purposes of taxation into two distinct classes: one the manufacture of chewing and smoking tobaccos and snuffs; the other the production of cigars, cheroots, cigarettes, etc. The factory production of tax-paid tobacco and snuff in the United States for the calendar year ending December 31, 1893, exceeded 250,000,000 pounds, subdivided into plug chewing, 148,000,000; fine-cut chewing, 14,000,000; smoking-tobacco, 76,000,000; and snuff, 12,000,000 pounds. Other materials aggregating 70,000,000 pounds annually—mainly sugar, licorice, malt, etc.—are added in various proportions during the manufacture of these products, to suit the taste of consumers.

The amount of tobacco and snuff exported during the same period was 15,500,000 pounds. In addition it is estimated that fully 28,000,000 pounds, representing the local consumption by growers, escape taxation. Statistics covering a series of years show that the percentage of consumption in our country of the various kinds of manufactured tobacco and snuff is: plug, 62 per cent.; smoking-tobaccos, 27 per cent.; fine-cut, 7 per cent.; and snuff, 4 per cent. During the past twenty-five years the improved methods of manufacture introduced in all the subdivisions of the tobacco industry have materially reduced the cost of production, with a corresponding decrease in price to the consumer. In manufactured tobacco and snuff the processes of cleaning, ordering, casing, drying, cooling, cutting, dressing, flavoring, weighing, packing, stamping, labeling, with the additional procedures in the cigarette manufacture of carding, rolling, wrapping, and cutting off, are now generally carried on by machine instead of hand labor.

The general consumption of the product of the tobacco industries of the United States has increased enormously during the past thirty years. Such increase has not been relative in its subdivisions. Based upon the collections of the internal-revenue department, the production of manufactured tobacco and snuff during 1863 was 24,000,000; 1865, 37,000,000; 1875, 119,000,000; 1885, 180,000,000; and 1895, 259,000,000 pounds. A comparison of the reports of the internal-revenue department with the last published report for the calendar year ending December 31, 1892, shows that the consumption

Pierre Lorillard, Jr.

of plug tobaccos has increased during this period 66 per cent.; fine-cut chewing, decreased 18 per cent.; smoking, increased 117 per cent.; and snuff, increased 201 per cent. The large number of cigar makers who have qualified as tobacco manufacturers for the purpose of sorting, sieving, and packing for sale their refuse scraps, clippings, and cuttings, accounts in a measure for the increased consumption of smoking-tobacco. The increase in consumption of snuff from 4,000,000 pounds in 1880 to nearly 12,000,000 in 1893, due in a large measure to its use for dipping purposes, is entirely at variance with the generally accepted view of the public that the use of snuff is fast becoming a relic of the past.

During the fifteen years ending June 30, 1895, the annual consumption of tax-paid cigars, cheroots, etc., increased from 2,682,000,000 to 4,164,000,000, an increase of 56 per cent.; and during the same period the annual consumption of tax-paid cigarettes has increased from 567,000,000 to 3,328,000,000, an increase of 486 per cent. While this increase has in both instances been annually progressive, it is apparent that the greater increased consumption in cigarettes has been at the expense of the cigar industry; for while the production of the former during the years 1894–95 was 270,000,000 in excess of the average for the past five years, the production of cigars, cheroots, etc., declined 250,000,000 during the same period of time. In addition there are annually manufactured for export about 2,000,000 cigars and 400,000,000 cigarettes. Aside from the cultivation, preparation, and handling of the raw material, according to the latest available statistics the various tobacco industries of the United States are carried on by 11,351 establishments, with an invested capital of nearly $100,000,000, employing 129,423 persons, whose annual wages aggregate $53,336,060, using material costing $79,491,209, and having miscellaneous expenses incident thereto aggregating $23,000,000.

I have thus endeavored, so far as the space allotted me would allow, to trace the progress and present status of the tobacco factories in the United States from the early cultivation of the raw material in the colonies to its present extensive production, both as the basis for one of our largest domestic industries, as well as furnishing one of the largest of our staples for export.

CHAPTER LXII

AMERICAN SOAP FACTORIES

SOAP making in the American colonies was largely a household art in the beginning. The thrifty housewife, utilizing the kitchen fats saved in the dripping-pan, made her own soft soap for domestic purposes, and even a species of hard soap, usually molded in the form of a ball, and of a quality that, though considered excellent in those days, would scarcely be used by housekeepers of to-day.

If the soap boiler proper, as distinguished from the household maker, attained little prominence in the early days, soap was still a product the preparation of the material for which afforded a flourishing colonial industry. So early as 1608, when the second ship sent out from England to the Jamestown colony arrived, there were landed a number of Germans and Poles, skilled craftsmen, among whom were several proficient in handling fat and soap-ashes. The superabundant timber of the virgin woodlands afforded every advantage to this industry. In 1621 soap-ashes for export to England were worth from six shillings to eight shillings per hundredweight, and fifty years later the settlements in that part of the country now included in Maine and New Hampshire derived their chief wealth from the fat and soap-ashes there produced.

The candle and the tallow dip, then the ordinary means of illumination, have always constituted in their manufacture a branch of the soap maker's business, but in those days it was a far more important one than it is to-day. Newport, R. I., had a number of these establishments by the middle of the last century. Boston and all New England were likewise active in this trade, owing to the large whaling interests there, which furnished the sperm-oil.

Such was the status of the soap industry at the beginning of the century which comes within the limits of this article. While there were small soap-boiling establishments in nearly all the large towns by 1795, it is safe to say that they did not produce a great deal over $300,000 annually. The bulk of the product consumed was, as has already been stated, home-made.

The earliest moving cause in the evolution of a small and comparatively unimportant trade into a great industry was the discovery by Leblanc, a Frenchman, in 1791, of his celebrated process for the manufacture of soda on a large scale. This discovery, although made so early, was not appreciated in its full significance until more than thirty years later, when chemical manufacturers and soap makers began to avail themselves extensively of the supply of soda thus cheaply afforded.

Prior to this latter event, however, the trade foundations of the great soap industry of to-day were laid by a few persons who were long-sighted enough to perceive the future requirements, and courageous enough to believe they could fulfil them. Among these, one of the oldest, as it is one of the largest, in both present and past importance, was the establishment of William Colgate, founded in 1806 in a modest way in the old building in Dutch Street, where the warehouses and offices have remained to this day. Fancy soaps were at this time unknown, and the makers of the American product contented themselves with a very common grade of soap. The same conditions prevailed in both Philadelphia and Boston; but so rapid was the advance that by 1835 we were supplying all the home demand, with the exception only of certain of the finest qualities of soap, the secret for making which was possessed by some English or French manufacturer. We were in addition heavy exporters, sending abroad, principally to England, nearly as much every year as we are bringing in from there to-day. The total imports of soap for 1835 were but $36,218, while of our home-made product of soap and candles there was shipped abroad $534,467 worth. In Great Britain the soap industry was hampered at

this time by a duty originally imposed in 1711, and not repealed until 1853. Despite this drawback, it is interesting to note, as showing the growing commercial and industrial importance of soap, that during the fifty years which followed 1801 the annual production increased from the amount as previously stated to over 197,600,000 pounds.

The increased importance of the soap industry thus developed in England, together with the many new uses to which the product was soon being put, especially as an auxiliary in other manufacturing processes, was speedily felt on this side of the water. Nevertheless the stimulation manifested itself rather in increased production than in improved quality.

Fifty years ago we were employing substantially the same methods and processes that were used in England. New England was then the principal center of the manufacture for the United States, although New York and Philadelphia were gaining prominence. At that time filling materials were practically unknown, and "settled" soaps were merely run into the wooden frames and crutched for hours, until rendered thick from cooling, or were finished by boiling down. The material was ladled by hand from the kettles into the frames, or put into buckets or tubs and carried and emptied into the frames. The kettles themselves had cast-iron bottoms, to which a wooden curb was fastened by means of cement. The composition of this cement, which was used to prevent leakage, was regarded at that time as a great trade secret, especially when the cement was capable of preventing the leakage for some length of time. The waste lye was run off through a pipe reaching through the wooden curb to a point near the bottom of the kettle. The kettles were heated by open fire, and the contents were kept from burning by stirring them with a long iron rod flattened at the end. The lye was made by leaching wood-ashes, since the use of caustic soda, although dating back to the beginning of the century, had made very slow advances.

While processes and methods were thus, comparatively speaking, at a standstill during the first four decades of the present century, the soap industry, nevertheless, steadily advanced in importance, and prepared itself for the wonderful development that immediately followed the discoveries of Chevreul in 1841. He demonstrated the true principles of saponification, and no later improvement, whether it be in the introduction of the steam processes or in the discoveries and uses of the many new vegetable and animal oils, has been of greater importance. The impetus thus given is shown in the fact that only one year later, in 1842, there were produced in the United States alone 50,000,000 pounds of soap, 18,000,000 pounds of tallow candles, and 3,000,000 pounds of wax and spermaceti candles, while exports to the value of more than $1,000,000 attested the preëminence we were gaining in the markets of the world. Of the total soap product at this time Massachusetts was credited with over one quarter, and of the spermaceti she produced nearly all.

Five years later, at the time when our house removed its factory to Jersey City, the soap industry had grown to great proportions. There were many manufacturers of soaps and candles in New York at this time, and among the more prominent of these I recall Enoch Morgan, James Buchan, Johnson, Vroom & Fowler, D. S. & J. Ward, J. D. & W. Lee, Holt & Horn, Patrick Clendenen, John Alsop, C. W. Smith & Company, John Taylor & Sons, W. G. Browning & Company, Lee A. Comstock, John Buchanan, George F. Penrose, John Ramsey, John Kirkman, and John Sexton. The manufacture of fancy soaps had already been begun, and in 1850 was established on an extensive scale by our house. Shaving-soap, always in great demand in those days, when beardless faces were the vogue, was also greatly improved in this decade, and many other of the common toilet necessities of to-day were either first brought out or developed to comparative excellence at this time.

In common, too, with almost every manufacturing industry of importance, the making of soap was soon facilitated by the introduction of machinery. American ingenuity, always on the alert for labor-saving devices, has since been active in this field as in others, and the improved and extensive equipment of the modern factory testifies to its success. Manual labor, which was the rule in the earlier days, has been replaced in many of the various processes by machinery that performs the work more expeditiously and at a reduced cost. There are specially constructed machines designed and adapted for almost every step in the different processes of manufacture where their introduction has been either feasible or of advantage. A technical specification of the nature and functions of these machines would not only require too much space, but it would be tedious as well to the general reader, and is therefore omitted.

There are various sources for the fats used in the production of soap. The berries of the soap-tree of South America and the West Indies possess excel-

lent natural qualities for the manufacture of soap, and the bark of the *Quillaia Saponaria*, from Peru, is used in Liverpool for washing woolens. In California the roots of the *Phalanjium Pomaridianum* are found in great abundance, and have the odor of brown soap; these are used for washing clothes. Different kinds of oils are used in the manufacture of soap, these offering different proportions of approximate principles of fatty bodies, such as stearine, palmitine, and oleine. Different kinds of alkalis used to unite with the fats produce soaps of varying hardness, soda making a harder soap than potash. The hardest soap is made by the use of stearine and soda, and the softest soap by the union of oleine and potash. Glycerine is often combined with fatty acids, since it is broken up by the action of the alkali, the glycerine then existing in a free state in the soap, or it may be extracted as a separate product. The principal fats and oils used in the manufacture of soap are tallow, and palm, rape, poppy, linseed, hemp-seed, and olive oils.

Olive-oil is used in the manufacture of Castile, Marseilles, and other marbled and plain soaps of southern Europe. Similar results by similar methods are attained in this country. The best oils for marbled soaps are obtained from Naples. The Spanish oils are also valuable for the same purpose. The oils from the East are not so rich in stearine, and contain a certain amount of green pigment, which make them less desirable. Mottled or marbled soaps are obtained by sprinkling the surface of the freshly made substance successively with lyes less and less concentrated. The saponification—which by its very Latin derivation shows that the manufacture existed among the Romans—is conducted ordinarily by boiling the fat with a solution of caustic potash or soda. Most fats require a long boiling with an excess of alkali, but lard, beef-marrow, and the oil of sweet almonds may be saponified merely by an agitation with caustic soda at an ordinary temperature.

Soaps are scented and colored by mixing coloring substances and volatile oils or odorous matter with them. Sometimes, for the purpose of producing a medicated soap, antiseptics, such as carbolic acid, creosote, chloride of potash, and sulphur, are mixed with the ingredients. A soap for the use of taxidermists in preserving skins is produced by the addition of arsenic. A large industry has developed in this country in scouring-soaps, which are produced by the addition of fine sand or pumice-stone to the ordinary soap when in its plastic state. The secret of the cleansing power of soap has never been satisfactorily explained; yet while it is generally supposed to be due to what is known as "hydrolysis," or partial decomposition into free alkali and insoluble acid soap, it is probably due, as a matter of fact, to the power of the solution to emulsionize fats.

The processes of soap manufacture are three in number, according to the ordinary classification. First, there is a process of direct union of free fatty or resinous acid and alkalis, a process which is not much in use. Second, there is the treatment of fats with definite quantities of alkalis, in which the glycerine remains with the soap. This is known as the "cold process." Third, there is the treatment of fats by boiling them with indefinite quantities of alkali and lye. The great bulk of soaps is hard soap, and this is of three kinds—the curd, the mottled, and the yellow. The finest quality of the curd soap is obtained by the use of tallow, the lye being concentrated by the use of close steam till the soap is hard. In producing mottled soap, while the process is the same as in the manufacture of the curd, darker fats are used, and concentration of the fats is not carried to such an extent as with the other. When there is a natural mottling of the soap it is an absolute guaranty that there is no undue amount of water present in it. The artificial mottling of soap is carried on to a very large extent for legitimate purposes; but there are those who practise it for the express purpose of fraud. The mottling process is largely used for laundry-soaps. Yellow soaps contain more or less resin, the finest qualities of such soap being secured by the use of light-colored resin and the best grade of tallow. The finishing or "fitting" of yellow soaps requires long experience on the part of the manufacturer for satisfactory results. The method of finishing all kinds of soap is a variable factor, depending upon the precise kind of article desired.

In the production of cocoanut or marine soaps the cocoanut-oil is saponified by the use of strong lye without salting. After several days of hardening the blocks of soap are first cut into slabs by means of a thin steel wire, and the slabs are then transformed into bars. These bars are stamped with the name of the maker and the brand of the soap, and are then ready for the market.

The demand for cheap soap has resulted in the introduction and extension of a process known as "filling." In this various substances designed to increase the detergent power of the soap, or to increase its bulk and weight, thus lessening its power, are introduced into the soap after it leaves the "copper." This process is also known as "crutch-

Samuel Colgate.

ing." The substances used as adulterants are water, talc, clay, chalk, sulphate of baryta, etc. In the production of soft soaps impure solutions of potash soaps are combined with glycerine in caustic lye, which results in transparent jellies.

In the production of toilet-soaps good curd or yellow soap is used as the basis, special precautions being taken against the presence of free alkali. The soap is cut into shavings. It is then partially dried, and, coloring-matter and perfumes being added, the composition is passed several times between granite rollers to make it homogeneous. The mass is then "clotted," which consists in the use of great pressure to form the soap into bars. These bars are then cut and stamped. The lower qualities of toilet-soaps are generally made by the "cold process." Transparent soaps are produced by dissolving good dry soap in alcohol, pouring off the clear solution, and then removing the bulk of the spirit by distillation. The soap remaining is then put into molds, cooled, and preserved for several months in warm chambers, until it becomes quite transparent. Many kinds of transparent soaps are made by the "cold process," the transparency being accomplished by the addition of sugar. Glycerine is often incorporated with opaque and transparent soaps for emollient effects, while for disinfecting purposes carbolic acid, cold tar, eucalyptus-oil, and other substances are added. The commercial value of all soaps depends upon the percentage of fatty anhydride present in them.

Having thus briefly reviewed the technology of the soap-manufacturer's art, we return to the consideration of the historical features of the subject. In the decade ending in 1850 the annual production of soap and candles had reached nearly $10,000,000, and by 1860 it had increased to still greater proportions. Its extent in that year, as well as in each succeeding decade, as gathered from the census reports of the United States, was as follows:

THE SOAP INDUSTRY, 1860 TO 1890.

Year.	Establishments.	Employees.	Wages.	Capital.	Material Consumed.	Value of Product.
1860	614	3,247	....	....	....	$18,464,574
1870	614	4,422	$1,925,951	$10,454,860	$15,232,587	22,535,337
1880	629	5,289	2,219,531	14,541,294	19,907,444	26,552,627
1890	578	9,305	4,951,648	....	28,687,412	43,600,385

The above figures demonstrate most clearly the growth that has been made by the soap-manufacturing interests, but they do not express another and most important phase of this industrial success. This is contained in the fact that American soaps are strong competitors in the markets of the world. Not only do we produce enough and to spare for our own wants, but we also send annually great quantities to foreign countries. Showing as this does the superiority of the American article, it is most gratifying; and the fact that England and France are still the most noted producers of toilet-soaps does not prevent me from declaring that we are producing here at home at the present time articles every bit as good, if not better than those made abroad, and that it is a question of only a short time before our superiority in this direction will be as freely conceded as it now is in the commoner grades of soap. The development and present importance of our foreign trade can be gathered from the subjoined table, giving the exports and imports of soaps by half-decades during the past twenty-five years:

EXPORTS AND IMPORTS OF SOAP, 1870 TO 1894.

Year.	Imports.	Exports.
1870	....	$627,352
1875	....	693,491
1880	$306,386	728,689
1885	401,150	697,294
1890	553,440	1,100,017
1894	578,810	1,139,722

Modern conditions have greatly changed the methods of soap manufacturers. Commencing with the introduction of the first pressed cakes of laundry-soap in this country by B. T. Babbitt, innovations and improvements have followed thick and fast. Upon the breaking out of the Civil War resin became very scarce, and other substances were added to the soap as substitutes. After the war, when resin became plentiful, there was a tendency to revert to the old methods of making soap; but late in the sixties the process of hardening resin soaps by the use of sal-soda was first introduced by A. Van Haagen, at that time of Philadelphia. Gradually

the process of recovering glycerine from waste-soap lye was perfected in England, but it has been improved upon here, so that now refined and chemically pure glycerine is made by a goodly number of soap factories. The manufacture of soap-powder pertains to this same period. White floating soap was first put upon the market by Procter & Gamble, of Cincinnati.

The introduction of sapolio also marked a new era in the soap business. It was a combination of true soap and scouring substances in such proportions as to increase to the highest point the advantages of each. The Bath brick of the scullery has gone since its advent, and the principle upon which sapolio was established is now utilized in many forms. Intense competition has burdened the business with enormous advertising expenses, with all the various ramifications thereon attendant, such as the "gift trade" of premiums in crockery, glass, lithographic art work, and household novelties. While the maker of the housewife's soaps has had increased by these things his cost of production, the manufacturers of the finer grades have been equally alert to keep abreast of the demand for artistic wrapping and boxing, with the result that thousands of dollars are annually expended for the purely esthetic requirements of the business. Despite all this, the best grades of soap are now made in the United States. In quality, form, and preparation they are equal to those made anywhere in the world, while along the line of mechanical facilities for operating upon large quantities of material with the greatest economy of time and labor this country is acknowledged to take the lead among the nations of the earth.

Among the great firms engaged in the business to-day, and identified with its progress, I might mention B. T. Babbitt, N. K. Fairbank & Company, James S. Kirk & Company, D. S. Brown & Company, Procter & Gamble, and Colgate & Company.

Thus far I have avoided all mention of perfumery, notwithstanding the fact that its manufacture is sometimes a subsidiary branch in the great soap establishments. The subject, nevertheless, is one that must properly come up for discussion by itself. Under the general head of perfumery are grouped a great variety of articles for toilet use, such as cosmetics, pomades, toilet powders, oils, depilations, dentifrices, sachet powders, etc. In their manufacture has been developed a business which more than almost any other demands the extremest care, taste, and experience on the part of the maker.

The hardy settlers and stern old Puritans who first came to America had little use and less desire for the sweet-smelling unguents of the Old World dandies. Accordingly it was long before perfumery was established as a manufacture here. In the proud old Tory days before the Revolution, and in the time of the Confederation which followed, perfumery, cosmetics, and the like were necessities in the toilet of any person of fashion. The carefully powdered hair and cue, the delicately scented shirt-frills and handkerchief, were all indispensable to the gentleman who wished to appear in good society. The supply of these articles, however, was drawn almost altogether from abroad, from the great centers of England and France. The housewife's rose-water, steeped lavender, and kindred preparations were generally known, and made by each family in quantity requisite for its own needs. As in the case of soap, so with perfumery, it took many years and changed conditions to bring the industry from the kitchen to the factory.

There are several methods for the extraction of the odoriferous qualities of plants, and for imparting them to spirits and oily bodies. For pomades the best fat to be procured is the marrow of the ox. An inferior source lies in the mixture of beef and veal fat and lard. These are beaten in a mortar, melted in a water-bath, and then strained. Before cooling the essential oil for the perfume is stirred in, or else flowers are thrown in and left to digest for several hours. These flowers are then removed, the fat is again heated and strained under heavy pressure, and fresh flowers are supplied. This process, known as maceration, is continued for several days; the product is then strained.

For delicate plants such as jasmine, tuberose, and cassia, the process employed is known as "absorption" or enfleurage. In this process square wooden boxes, the bottoms of glass plate, are used. In these is first placed a layer of purified lard and suet mixture; freshly gathered flowers are placed upon this layer every morning. The boxes are then shut, and the grease finally acquires a very strong odor from the flowers. For the saturation of oils the boxes are supplied with a wire bottom, on which cloths are placed after being soaked in the oil. After being charged the cloths are placed, several of them together, under heavy pressure, and the perfumed oils are thus regained. For the scenting of spirits the process of maceration or of digestion with essential oils is conducted in a water-bath and by agitation for several days. Perfumed soaps are prepared by substituting pomades for the grease in the mixture of soda lees.

The meagerness of the records, and the difficulty of distinguishing between the perfumer who dealt in imported articles, or at best made but one or two special and usually simple scents in limited quantity, and the actual American manufacturers, prevent as full a history of the early trade as might otherwise be given. It is certain that perfumery was being made in the United States, and in steadily increasing quantities, during each of the first four decades of the present century. The impetus given to the soap industry early in the forties by Chevreul's discovery reacted directly upon the production of perfumery. Many Frenchmen, skilled perfumers, had come to this country, and were vying with the American manufacturers for a trade that was already most profitable. Distinctive American scents had been introduced and become popular. "Ask for Cream of Lily," or "Take nothing but Violet Blossom," were advertisements illustrating the extent to which the business had grown. Among the manufacturers in New York at this time—between 1845 and 1847—were Thomas Jones, John Lindmark, Levi Beals, John Wyeth, Johnson, Vroom & Fowler, James Mackey, John Ramsey, William White & Company, Robert Reed, and John B. Breed. The French element in the trade was represented by such houses as J. M. de Ciphlet, F. F. Gouraud, August Grandjean, and Eugene Roussel.

Since then the growth of the trade has been great, and its importance is steadily increasing as American processes, intelligence, and push bring their forces to bear in competition with the great established centers abroad. The foreign strongholds of the perfumery industry are London, Paris, and the Mediterranean cities of southern France, together with the rose-growing regions of Turkey and Persia, where the manufacture of the ethereal attar of roses is carried to great extent. Cannes is famous for its roses; Nimes for its thyme, rosemary, astic, and lavender; Nice for its violets and mignonettes; Sicily for its lemons, bergamot, and orange perfumes. In England some essential oils are obtained from the native herbs, as at Mitcham in Surrey, where tons of peppermint and lavender are often distilled at a single operation. In the northern part of the United States there are many essences and essential oils manufactured from scented woods and herbs, such as wintergreen, sassafras, and others. Peppermint and roses and other flowers from gardens, fruits, seeds, and other vegetable products are unlimited sources for the production of this fascinating article.

The delicate scent of flowers has been traced to certain oils and ethers which may be elaborated from substances possessing even disgusting odors. The fetid fusel-oil affords odors which, obtained by processes of differentiation, are the same as those of fruits. Oils from gas-tar yield bitter-almond odors or the essence of mirbane. These are extensively used for perfuming soaps, and in many instances are regarded as preferable for culinary uses and the perfuming of confectionery. Then we have perfumes supplied from animal sources as well as vegetable. Among these are musk, civet, ambergris, and hartshorn. Ambergris supplies the most ethereal odors for use in combination with other perfumes. The greatest number of materials for perfumes (this being twenty-eight) comes from the south of France. Among these are the orange and the jasmine flowers, which form the bulk of the product, and also violets, roses, cassia, and tuberoses.

The progress made by the perfumery industry in this country during the last four decades is best shown in the following tabulated statement, taken from the United States census reports for the years noted:

PERFUMERY AND COSMETICS, 1860 TO 1890.

Year.	Establishments.	Employees.	Wages.	Capital.	Material Consumed.	Value of Product.
1860 [1]	33	535	....	$597,000	....	$1,222,400
1870	64	727	$260,415	1,172,900	$892,219	2,029,582
1880	67	741	238,259	813,827	1,201,409	2,203,004
1890	157	1,755	877,679	....	2,128,420	4,630,141

[1] The statistics for this year include the manufacture of fancy soap.

Of our foreign trade in perfumery there is little to be said, except that its condition has been and is encouraging. France and England, controlling as they do to a great extent the supply of raw material, have long been regarded as rulers of the perfumery market. Nevertheless this country has for many years sold abroad nearly as much as it has imported. In 1894 the figures show the imports to have been of the value of $427,850, while the

exports were but $327,835, or, speaking roundly, $100,000 less. This disparity, however, is not so great as it at first appears, owing to the fact that the classification of imports includes toilet preparations of every description, embracing many articles excluded under the export grouping. At home, with an annual production at the present time certainly amounting to, if not in excess of, $5,000,000, the progress of the last quarter of a century is plainly evident. Among the great firms active to-day in that advance throughout the country are Colgate & Company, Lundborg, Lazell, Dalley & Company, Theodore Ricksecker, Solon Palmer, Alfred Wright, E. W. Hoyt & Company, Lanman & Kemp, and Frederick Stearns & Company. Great, however, as has been the advance made here in both this and the soap industry, it is safe to predict that its full extent is not yet reached. An increased capital, a wider knowledge of applied chemistry, and a development of internal resources are all tending to place us at no distant day in the very van of the world's progress in these industrial arts.

Samuel Colgate

HENRY BOWER.

CHAPTER LXIII

THE CHEMICAL INDUSTRY

LABOR is a combined effort of the animal kingdom, led by mankind, to overcome and subdue, to subject and utilize, the forces of nature. Labor, in its various relations, assumes forms that are both psychical and physical in character. Groups, combinations, and subdivisions of these forms exist in the great war of the animal kingdom on the solid, fluid, and gaseous conditions of matter. Hence it is that the chemist and chemical manufacturer are called on to organize and array the final attack on all known productions of the earth, of the water, and of the atmosphere.

The chemical industry of the United States may be considered to have been in existence, at this time, about one hundred years. In common with other leading manufactures, it has reached large proportions. Almost every State of the Union has chemical establishments of some kind. The industry is affected for good or bad in quick response to the rise and fall of other manufactures.

Before the Revolution no chemicals were made here. From such reports as are obtainable it appears that 8000 pounds of copperas were made in Vermont in 1810, and a smaller quantity in Maryland in the same year. In 1813 alum was made in the latter State. Oil of vitriol was manufactured in Philadelphia in 1793. At Baltimore, the manufacture of chemicals, paints, and medicine began in 1816. In the census of 1820, two chemical establishments were reported from New York City.

By 1830 the industry was firmly established in the United States, Philadelphia being the center. There were then thirty firms in the business in the entire country, having a capital of $1,158,000, and producing articles valued at $1,000,000 per annum. Alum, copperas, and some other articles were manufactured to the almost entire exclusion of the foreign product. The list of productions included calomel and various other mercurial preparations, Glauber's and Rochelle salts, tartar emetic, ammonia, sulphate of quinine, oil of vitriol, tartaric, nitric, muriatic, oxalic, and acetic acids, aqua fortis, Prussian blue, chrome yellow, chrome-green, refined saltpeter, refined borax, refined camphor, acetate and nitrate of lead, prussiate of potash, and bichromate of potash.

The totals for the chemical industry, as reported in 1890, are shown in the following summary:

CHEMICAL INDUSTRY IN 1890.

Number of establishments reporting	1,626
Capital:	
Direct investment	$168,462,044
Value of hired property	$12,098,037
Miscellaneous expenses	$13,640,343
Average number of employees	43,701
Total wages	$25,321,077
Officers, firm members, and clerks:	
Average number	5,953
Total wages	$7,464,260
All other employees:	
Average number	37,748
Total wages	$17,856,817
Cost of materials used	$106,521,980
Value of products	$177,811,833

The principal products reported, and their quantity and value, were as follows:

CHEMICAL PRODUCT: QUANTITY AND VALUE.

Products.	Quantity.		Value.
Alum	(lbs.)	93,998,008	$1,616,710
Coal-tar products			687,591
Dyeing and tanning extracts and sumac	(lbs.)	187,906,911	8,857,084
Gunpowder and other explosives	"	125,645,012	10,993,131
Fertilizers	(tons)	1,898,806	35,519,841
Paints, colors, and varnishes			52,908,252
Pharmaceutical preparations			16,744,643
Potash and pearlash	(lbs.)	5,106,939	197,507
Sodas	"	333,124,375	5,432,400
Sulphuric acid [1]	"	1,384,776,972	5,198,978
Wood-alcohol and acetate of lime			1,885,469
Chemicals (including all acids, bases, and salts not heretofore enumerated)			24,751,974
All other products			13,018,253
Total value			$177,811,833

[1] Includes 581,536,200 pounds manufactured, and consumed in the manufacture of fertilizers, for which no value is given as sulphuric acid.

The most important of all chemical products is sulphuric acid, which maintains its supremacy over any other known article in promoting the manufacturing interests of the world. By the census of 1890, 105 establishments were reported as engaged in the manufacture of this acid, the production being 1,384,776,972 pounds. Of this quantity, 581,536,200 pounds, estimated as being worth $2,480,495, were produced and consumed as an intermediate product by establishments manufacturing fertilizers. Taking this into account, the total value of all sulphuric acid manufactured in the United States during 1890 was $7,679,473, an increase in value of 109.71 per cent. over 1880, and in quantity of 348.49 per cent. The large increase in the number of establishments and in the quantity produced, together with the reduction in price, indicates the advance that has been made in general manufactures in the United States during the decade intervening. Of the 1,384,776,972 pounds reported, 1,009,863,407 pounds were 50° Beaumé acid, 20,379,908 pounds were 60° acid, and 354,533,657 pounds were 66° acid. Reduced to a uniform strength of 50°, the total production for the year was 1,567,138,777 pounds. Supposing all of the chambers to be running 365 days in the year, we find the amount of 50° acid and equivalents manufactured in each twenty-four hours to be 4,293,531 pounds, or 2147 tons.

From technical considerations, manufactured manures are the next in importance to sulphuric acid in the category of chemical productions. The total of 1,898,806 tons of these materials produced, indicates, by no inaccurate measure, the extent of the farming interests of the country. When we consider that about 300 pounds of artificial fertilizer are commonly used to one acre of land, it is seen that 12,658,700 acres were enriched by its use. Dr. David T. Day, chief of the Division of Mines and Mining, states that 375,000 tons of fertilizers were consumed during the last census year in the Southern States, leaving 1,523,806 tons as the consumption of the Eastern, Middle, and Western States. The increase in manufacture over 1880 is 1,171,353 tons, or about 161 per cent. These figures show that large areas of our country are becoming unprofitable to farm without the use of these aids to fertilization; and the existence of factories in the States of California, Illinois, Indiana, Michigan, Minnesota, and Wisconsin is indicative of the gradual exhaustion of soil that was virgin in character less than twenty-five years ago. These facts tend to show that the time is approaching when none of our unmanured soils will yield in remunerative quantity. They prove that economies are coming into practice in the utilization of material that formerly ran to waste.

The farmer occupies a reversed position to that of the manufacturer of artificial manures. By prodigal wastefulness and culpable ignorance he permits immense quantities of manurial matter to find their way to the sea, while bemoaning his lot and sighing over the yield of virgin lands in comparison with that of his own; whereas the manufacturer, by the aid of chemical skill and mechanical devices, converts refuse matter into valuable merchandise.

The figures presented here yield consolation to the farmers of the Atlantic slope. When the not distant time arrives for the extinguishment of an agriculture that is based on primordial soil, the lands of these regions will recover their lost value; for the facts herein submitted tend to show how closely fertility is allied to the production of manufactured manures, and this manufacture can be carried on most profitably at those points where supplies of foreign crude material can be obtained, and where seaboard transportation can be made available.

The decade between 1880 and 1890 is rendered memorable to the chemical industry by the permanent establishment of the manufacture of soda salts in the United States. Previous to that time all attempts to produce these articles successfully from common salt had failed. The causes that led to repeated failure and the consequent loss of large sums of money are to be found in the high cost of labor, the absence of customs-duties on bleaching-powders or chloride of lime, and the exceedingly low rates of ocean freight that rule on this class of merchandise.

The Solvay Process Company, of Syracuse, N. Y., has been founded on the experience and skill of the now noted Solvay, of Belgium. But, however satisfactory the process may be, it has a drawback that affects the production of many articles in the United States,—notably bleaching-powders, paper stock, and certain chemicals,—inasmuch as all the chlorine of the common salt employed is lost, passing away as valueless chloride of calcium. Consequently the United States remains dependent upon Great Britain and Germany for its supply of so important an article as bleaching-powder.

A question of the greatest interest centers in this problem—how to overcome this defect in our manufacturing system. The efforts of inventors have for many years been directed toward the solution.

Theory has marked out a number of paths, but practice has not yet succeeded in following any of these to a satisfactory result. It may be remarked that, in addition to bleaching-powders, the important chemicals, alizarin, chlorate of potash, and chlorate of soda, are not found among the salts produced in this country, and that these articles, so essential to the textile interests, are free from customs-duty.

The States of the Union often provide chemical manufactures relatively to their natural products; but the markets for chemicals are situated chiefly at such attractive points as the great centers of textile manufacturing, of dyeing and bleaching works, and of the oil-refineries and artificial-manure works; hence, chemical works are to be found principally at or near these points. It appears from the report for the Eleventh Census on the dyeing and finishing of textiles, considered as a distinct industry, prepared by Mr. P. T. Wood, that chemicals and dyestuffs to the value of $8,407,693 were consumed by the 248 establishments engaged in this industry, to which must be added $11,278,970, the value of chemicals and dyestuffs consumed during the census year by textile manufacturers who do their own dyeing and finishing, making a total of $19,686,663 as the value of this class of chemicals consumed in the textile industry.

The leading articles of raw material and their derivatives used in chemical manufactures, briefly stated, are as follows:

RAW AND MANUFACTURED CHEMICALS.

Raw Material.	Manufactured Articles or Derivatives.
Brimstone or sulphur; pyrites containing sulphur.	Oil of vitriol, or sulphuric acid, the most important of all chemicals.
Nitrate of soda.	Nitric acid and all nitrates.
Salt (common).	Soda; muriatic acid.
Potash salts.	Bichromate of potash, prussiate of potash, and many other combinations.
Nickel ores.	Salts of nickel, for plating.
Chromic-iron ores.	Chromates of potash and soda.
Antimony ores.	Alloys; medicinal salts.
Bismuth ores.	Alloys; medicinal salts.
Copper ores.	Sulphate of copper, or blue vitriol.
Cobalt ores.	Oxide of cobalt.
Iron ores.	Sulphate of iron, or copperas.
Lead ores.	White and red lead; litharge.
Manganese ores.	Disinfectants; chlorine.
Mercury ores.	Calomel; white and red precipitate; vermilion.
Zinc ores.	Oxide of zinc.
Gold.	Chloride of gold.
Silver.	Nitrate of silver.
Innumerable vegetable productions.	Dyeing extracts; alkaloids; acids; and pharmaceutical preparations.
Linseed.	Paints.
Cotton-seed.	Soap; oils used in cooking.
Cotton.	Guncotton.
Corn and all cereals.	Glucose; alcohol; starch.
Wood.	Explosives; oxalic acid; potash; acetic acid; paper.
Argol or tartar.	Tartaric acid; cream of tartar.
Borate of lime.	Borax.
Barytes.	Paints.
Chalk.	Whiting.
Iodine.	Sublimed iodine; all iodides.
Limestone.	Lime; carbonic acid.
Magnesia.	Carbonate and sulphate of magnesia.
Ochres.	Paints.
Crude phosphates.	Phosphorus.
Fats.	Soap; glycerine.
Animal matter, such as horns, hoofs, and leather.	Prussiate of potash; artificial manures.
Oils.	Soap; perfumes.
Coal (bituminous).	Ammonia; coal-tar colors; cyanide of potash.
Clays.	Alum.
Corundum.	Aluminium.
Cryolite.	Alum; soda.
Silica or sand.	Silicate of soda; glass.
Tin.	Tin-salts, for dyeing purposes.
Atmospheric air.	Oxygen.
Water.	Gas; hydrogen; oxygen.

The innumerable variety of combinations made of the raw materials named renders it impossible to state them in any limited space. The variety of raw materials, and of the numberless combinations thereof, gives to the chemical industry a unique position. No other branch of manufacture can approach it in scope, in the necessity for its existence, or in the knowledge required for its prosecution.

The merchandising in chemicals is of a complex character, and is based chiefly on chemical tests, both of the raw materials and of the manufactured articles. The markets of all quarters of the globe are scanned, and supplies, in many instances, are carried in large quantities, owing to the remote points of their production. The chemical industry affords one of the largest sources for transportation to railroad and water carriers, in raw materials as well as in partly finished and wholly manufactured stuffs. In many articles the competition of countries enjoying low prices for labor is difficult to meet. On the other hand, through advantages not enjoyed by foreign manufacturers, considerable exportation of certain chemicals is going on at this time.

The industries or trades dependent upon the manufacture of chemicals may be enumerated as follows:

INDUSTRIES USING CHEMICAL PRODUCTS.

Woolen manufacture.	Tanning.
Cotton "	Glass manufacture.
Silk "	Soap "
Oil-cloth "	Artificial ice manufacture.
Explosives "	Pharmaceutical "
Pyroxylin "	Pyrotechnic "
Paint "	Electrical or galvanic manufacture.
Glucose "	Printing-inks manufacture.
Artificial manures.	Paper manufacture.
Oil refining.	

Bleaching-works.

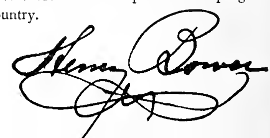
The plant of a chemical works involves the use of a larger area of land than is necessary in other manufactures, as the buildings adaptable to the operations are usually only one story in height, nearly all the work being done on the ground floor, where large furnaces, grinding-mills, and engines can be placed. This is one reason that the capital required for the conduct of these manufactures seems disproportionate to the value of the products, in comparison with other branches of industry. In the eyes of one unversed in the art, a chemical works may appear to be only a mass of rude furnaces, old pots, and rough machinery; yet the establishment may contain appliances of the most costly description, such as underground flues; furnaces of the most modern construction; iron castings fashioned in innumerable forms and weights; copper vessels, coils, and stills; thousands of fire-bricks and other forms of refractory material; steam boilers of the most economical pattern; lofty chimneys; powerful engines; expensive pumps; mills of different kinds for the grinding and powdering of a great variety of materials; leaden chambers for acid making, with tanks, towers, and accessories of the same metal; platinum apparatus and stills for concentrating sulphuric acid; and chemical earthenware, vitrified to resist the action of acids. Indeed, it may be stated that a chemical works of any magnitude contains and requires every manufacturing appliance used or known, excepting those adapted especially to weaving and printing.

Skill and scientific knowledge are needed in the successful conduct of manufacturing chemistry at this time to an extent unthought of by the men who were good workers twenty years ago. The competition of scientific Germany in many departments of chemical manufacture has forced the progress of an industry that was yet in its infancy two decades ago. The laboratory, well equipped with careful workers and good apparatus, has become the pulse of the whole establishment. Each step in the processes is indicated in the unerring results obtained by the analyst and tester, while the huge and costly machinery of the factory is the counterpart, to a great extent, of the miniature equipment of the laboratory. Chemical engineering is an important factor in the adjustment of plant to the exigencies of the difficult and tortuous operations. Some institutions of learning have recognized this fact by adding to their curriculum a course of chemical engineering. The advance in the manufacture of chemicals in the United States during the past twenty years has been marked, not by many changes of processes, but essentially by the new appliances furnished by engineering skill.

The processes used in making chemicals are almost as varied as are the articles produced, but certain leading steps are essential to all, as grinding, furnacing, dissolving, separating, evaporation, filtration, and crystallization. The laws governing chemical constitution are closely followed at each step, and the processes improved and revised, from time to time, by the aid of mechanical contrivances. These changes are rendered more and more necessary as the strong competition of the age sweeps away old and unsuitable appliances.

Many chemical operations demand a long time for the production of finished material. Crystallization is of slow growth in many instances, and decomposition takes place very gradually in others; therefore another reason presents itself for the abnormal amount of capital required to carry on this branch of industry. Both crystallization and decomposition are hastened or retarded by many physical conditions; heat and cold, intense motion, and absolute quietude are in their turn called to the aid of the chemist. When we speak of crystallization we should bear in mind the fact that by this process the great purity of commercial chemical salts is obtained—sometimes, it may be, by frequent dissolvings and as many distinct crystallizations.

The chemical industry takes rank as the fourth among the great manufacturing divisions of the country, the three preceding it being (1) iron and steel, (2) woolen goods, and (3) cotton. (It may be well to explain that cattle killing, the making of clothing, and of boots and shoes, and any other assembling industries are not considered manufacture proper.) The chemical industry represents a diversity of interests such as center in no other department, and it affords to the United States a source of activity for labor, skill, and capital that is highly encouraging to those who have pride in the progress of their country.



CHAPTER LXIV

THE LEAD INDUSTRY

LEAD was known, probably, to the earliest peoples of the earth. Its use antedates written history, and its abundant occurrence in nature, taken in connection with the ease with which it is reduced from its ores, leads archæologists to infer, even when little mention and few traces are found, that the ancient nations were familiar with its properties. Egypt, when the pyramids were building and the golden serpent of the Pharaohs still represented living royalty, knew the plumber's metal and used it, either as an alloy for her wondrous bronze, or in native form for small images and amulets. The armies of Thotmes III. brought it back with their spoils from Mesopotamia, and made it into sling bullets, the Egyptian slingers using it, as did the Persians, and later the invincible legions of Greece and Rome. Babylon used lead to render moisture-proof the famous hanging gardens; Troy, ere Hector fell, and Priam, saved by the most dutiful of sons, became a wanderer, made images of lead; and the Phenician mariner, steering his bark across the sea by the glittering constellation of the Little Bear, not only carried it in his hold, consigned to the great storehouses of Sidon and Tyre, but the hollow tubes of his anchors were weighted with it as well.

Greece and Rome knew lead as well as we of to-day. Conquered Britain yielded to the Roman not only the "imperial tenth," but her immense stores, which produced thousands of tons, and which Rome claimed, in fee forceful, and took. Spain also yielded the Romans thousands of tons, and the mines of the Urals were works of antiquity when Cæsar was a child. Nearly every land on earth found more or less lead within its borders, and the mining of this metal in a small way was almost universal at the time America loomed up before the European imagination as the world's El Dorado. Naturally so base a metal as lead was not the objective treasure of the adventurous miners and metallurgists who first struck their picks into American soil. Gold and silver they sought, and if for many years they found little, their search at least developed many mines and regions, as perhaps the too easy discovery of the yellow metal they coveted might not have done.

The first American lead discovered, by white men at least, was in 1621, in the vicinity of Falling Creek, near Jamestown, the original English settlement in Virginia. Iron-smelting works had been erected by the London Company, and an expert metallurgist named John Berkeley was put in charge. Berkeley, in addition to his services rendered to the company, did a little prospecting on his own account, which developed the existence of a vein of galena —the sulphide and commonest ore of lead. He worked this secretly, and supplied his neighbors with lead for bullets and other purposes; but cupidity caused him to keep the location of the vein a secret, so that when, a year or two later, he was killed by Indians, his secret died with him. A few years later a friendly Indian disclosed the location of the old mine, and the lead deposits of Virginia have been worked more or less ever since, although the output has never been very great. Lead was also early discovered in Connecticut and Massachusetts, and by the middle of the last century valuable workings were open in New York State. The lead-mines of the East, however, have never been of such importance as those of the great central and Western regions of the Upper Mississippi and in Missouri, which were early developed by the French. The lead-fields of the Galena district, comprising portions of Iowa, Illinois, and Wisconsin, which have been among the most productive in the world, are believed to have been first discovered and worked by an Indian trader named Nicholas Perrot, who explored from the Canadian settlements of the French as far as the river Des Moines during the last of the seventeenth century. By 1690 the Indians living in the

regions about Galena were smelting and selling lead to the French traders. The region contiguous to the present city of Dubuque, which was one of the richest lead districts in America, was also first worked by a Frenchman, Julien Dubuque, who settled among and made friends with the Sacs and Foxes in 1774, just prior to the Revolution.

The Indians in 1788 granted to Dubuque the mine he had discovered, known as Prairie du Chien, and in 1796 the grant was confirmed by Baron de Carondelet, the French governor-general of the tract called Louisiana, which included the present States of Missouri, Arkansas, Mississippi, Louisiana, parts of the States of Kentucky, Tennessee, and Illinois, and all the broad lands to the westward. Dubuque worked his mines until his death, in 1809, when the Indians, after burying him with tribal ceremonies in a massive leaden coffin on the great bluff which bears his name, reclaimed them from Dubuque's creditors, and held possession until their removal from the district, in 1832, by the United States government. Dubuque's heirs at once claimed the property, but the government ejected them; and legal squabbles kept the status of the district in a most uncertain condition until 1847.

The mine La Motte, upon the head waters of the St. Francis River, a great lead property, was also discovered by a Frenchman, the famous adventurer and explorer, M. de la Motte-Cadillac, who founded Detroit. La Motte discovered the celebrated Golden Vein sometime between 1715 and 1719; but authorities differ as to the precise year, William H. Pulsifer, in his "Standard Notes for a History of Lead," seeming to incline to the former date. The lead-fields in the vicinity of Potosi, Mo., were discovered about 1720 by Philippe François Renault, and in 1763 the extensive fields known as Mine à Burton were discovered by Francis Burton, who in 1798 granted about one third of his claim to Moses Austin. The latter erected improved furnaces for smelting, sunk the first shaft ever seen in a lead-mine in that district, and began the manufacture of shot and sheet-lead. Around this industry grew up the town of Herculaneum.

The condition of the lead-mining interests of the country in 1795, when the century of which this paper properly treats began, was as outlined above. Minor workings in the Eastern States, while they produced but a comparatively small output, were the only really American interests.

France and Spain, with their respective territories of Louisiana and Florida, had jurisdiction over nearly all the valuable mining lands of the lead region; and even in those districts where the United States had acquired rights, the mining privileges were usually in the hands of the French and Indians, who recognized their value and were slow to part with them. The Indians, in particular, made the rich surface sheets of galena a source of continual profit. Their methods of smelting were crude in the extreme, consisting usually of a small hole dug in the ground and lined with rocks. This was usually located on a side-hill, both for the purpose of getting a strong air-draft, and also in order that a small tunnel connecting with the bottom of the furnace-hole might be dug, through which the molten lead could run off when the galena and fuel were thrown in and fired. Rough pigs, run in a scooped-out hollow of the earth itself, and weighing about seventy-five pounds, were usually made by the Indian squaws and taken to the trading-posts for barter. This method of smelting was wasteful, but with the practically unlimited supply it made little difference, and almost any man who found either a pocket of the "float" mineral or a small vein could mine and smelt it roughly himself. As the surface deposits became exhausted, and the miners had to go deeper, while at the same time improved and economical methods of reducing the ore became necessary, more capital was required and the works became more extensive.

There is probably no ore that reduces more readily than galena, yet at the same time the volatility of the molten lead permits great loss from careless methods. The composition of the ore, which, as before stated, is a sulphide, is about eighty per cent. of lead, frequently carrying more or less silver, and sometimes nickel, cobalt, or antimony, with about seventeen per cent. of sulphur. Simple roasting suffices for its reduction, the sulphur combining at a low temperature with the oxygen of the air, and passing off. This is, in its simplest statement, the process by which lead is extracted from this ore; and either open furnaces with strong draft, or reverberatory furnaces, are used. Unfortunately a considerable quantity of the lead passes off in fumes from the furnace. In remedying this, some of the modern smelting-works have found it profitable to build a very long funnel-pipe, through which the fumes from the furnace are passed before they reach the air. During this passage they are cooled, and a very appreciable quantity of lead in the form of powder is deposited along the pipe.

Another and great discovery was not made in this country until 1838, when cerusite, or the lead carbonate, was found by the American miners to be

reducible and a valuable ore. This ore, previously thrown away by the miners, who called it "dry bone," was found in large quantities, and its utilization very greatly increased the annual output during the decade following. Under this stimulus, and the litigation over the more important lead regions having been settled, the output of the mines in the Galena district jumped from 664,530 pounds in 1825 to 54,494,856 pounds in 1845. The decade between 1840 and 1850 witnessed the high-water mark of the lead interests in America up to the time that the Western lead-fields were opened. The rich properties of the Mississippi and in Missouri yielded plenteously, and in their eagerness the mine owners allowed themselves to glut the market, with the inevitable result that prices fell and the entire lead industry received a set-back from which it was some years in recovering. The Jasper County lead-fields, which have built up the town of Joplin, Mo., were also discovered during this decade, in 1848. Operations were carried on in a small way, but no general attention was attracted to this district until a dozen years later, when, in three years, 17,500 tons were produced from these mines. Since then the annual output has been as great as 17,765 tons, and in one year (1884), the disastrous one for all lead interests, as little as 2665 tons.

American lead-mines held but a poor third place among the productive fields of the world, however, until well into the seventies. England and Spain each produced greater quantities of lead than the United States in 1872; but the development, about this time, of the great Western deposits of argentiferous galena, which had been discovered in 1864, changed all this. This rich region, neglected on account of its inaccessibility to a market, suddenly took on life and activity with the extension of the railroads through the territory. In 1877 the Eureka district was turning out nearly 20,000 tons of lead annually; the Utah lead-fields, worked by the Mormons, were producing 15,000 tons annually so early as 1873, and by 1877 the output had increased to 27,000 tons for the year. Colorado was a year later in showing respectable results for her workings, but by 1883 the output of the mines of that State amounted to the tremendous total of 70,557 tons. This marvelous increase was largely due to the cerusite deposits at Leadville, which were first worked in 1878, and from which fully one half of the total lead production of the State was derived.

These Western lead ores were, almost without exception, very rich in silver. While silver in small quantities is found in all galena, and has been extracted even from the ores of the Mississippi and Missouri lead regions in quantity ranging from six to twenty ounces per ton, it was only in the Western mines that the precious metal was found in quantity sufficient to make the lead a by-product so far as relative values were considered. So little was thought of lead, in fact, that in the earlier days, when transportation was more difficult and expensive, the ore was cupeled at the mines, and only the silver brought to market. For this reason the lead output has been more or less dependent upon the silver market, but this is beginning to change. Lead itself has gained a place in the useful arts and manufactures that cannot be ignored, and its supply must be maintained. Owing to this the production of the American mines has been developed to a point far in excess of the figures of twenty years ago. The year following the development of the Western argentiferous deposits the United States was producing as great a quantity as was England in 1872, when she was the great lead miner of the world. Less than ten years later the annual output of the American mines had reached a figure greater than the combined production of England, Spain, and the United States in 1872, and the increase was steadily maintained.

In the foreign commerce of the nation lead has, within the past five years, come to play a far more important part than it ever did before. In 1885 the imports of lead and its manufactures were only $486,436, and the exports $123,466. In 1890 the figures had only increased to $657,658 for the imports and $182,412 for the exports; but the very next year saw a marvelous advance, which has continued ever since. The importation of silver-bearing ores, containing much lead, has also become an important matter, and until the silver repeal bill was passed, and the "bull" days for that metal ceased, Mexico had a great interest in that direction. The figures for the past five years, excluding 1895, for which full reports are not yet published, are as follows:

VALUE OF LEAD IMPORTS, 1890 TO 1894.

Year.	Lead, and Manufacture of.	Silver-Bearing Ore.
1890	$657,658	$7,748,572
1891	2,560,886	8,953,608
1892	3,653.378	9,656,761
1893	5,792,624	11,100,747
1894	6,606,865	6,679,171

The exports during the same period show only a comparatively slight gain, having ranged from $182,412 in 1891 to $638,636 in 1894.

During the sixty-five years between 1825 and 1890 the production of the lead-mines of this country amounted to the almost incredible total of 5,324,794,000 pounds, or, expressed in the briefer figures of commerce, to 2,662,397 tons. The product, as summarized for the same period by the demi-decades, will give, if the previous explanation of causes is borne in mind, the best illustration of conditions, rise, and progress in the lead industry that can be drawn. Up to 1873 lead was almost entirely obtained from the non-argentiferous ores of the Missouri and Mississippi regions; but after 1875 the table specifies the relative quantities from the two grades of ore. The figures given are in the standard short ton:

PRODUCTION OF LEAD, 1825 TO 1894.

Year.	Total.	Non-Argentiferous Ore.	Argentiferous Ore.
1825	......	1,500	....
1830	......	8,000	....
1835	......	13,000	....
1840	......	17,000	....
1845	......	30,000	....
1850	......	22,000	....
1855	......	15,800	....
1860	......	15.600	....
1865	......	14,700	....
1870	......	17,830	....
1875	59,640	24,731	34,909
1880	97,825	27,690	70,135
1885	129,412	21,975	107,437
1890	161,754	31.351	130,403
1892	213,262	31,678	181,584
1894	159,331	37,686	121,645

In the production of the 161,754 tons of metallic lead in 1890 the smelting and refining works employed 6131 men, to whom was paid in wages for the year $4,228,634.15. This sum, together with $5,154,682.04 paid out for supplies and materials, and other charges incidental to the carrying on of the business, brought the total expenditures for the year to $11,457,367.25.

Between lead crude, and cast or hammered into some required form, and lead manufactured, chemically changed, and metamorphosed, there is a great break in time. The chief of all the products of lead manufacture is, of course, the carbonate, which was the psmithium of the Greeks, the cerusa of the Romans, and is the white lead of to-day. As a pigment and base for colors it finds its chiefest use, its well-known body and opacity and ready assimilation with linseed-oil, which is the best of all vehicles for coloring-matters, making it the best substance man has yet discovered for this purpose. Other important lead products are litharge, the yellow protoxide; minium or red lead, which is a combination of the protoxide with a peroxide; orange mine or orange mineral, made by heating white lead; and lead acetate or sugar of lead. There are several other forms in which lead combines, but the substances already given are those of most importance in the arts.

In point of antiquity the oxides seem to have been longer used than the white lead, no traces of which are found in the wall-paints of the Egyptians, Hindus, or other ancient peoples; whereas the oxides are found to have been used both for the glazing of pottery and in colors. White lead was first brought into extended use by the Romans; and Rhodes, the manufacturing center of antiquity, was the place from which the finest was obtained. Roman women used the ceruse as a cosmetic—a use it also found among the Athenian belles; and minium was used as rouge. In these peculiar uses, despite the well-known injurious qualities of lead, the same substances have remained up to a comparatively recent date. White lead was also used by the Romans as a body for their paints, and both it and its manufacture are described by such ancient writers as Theophrastus, about 300 B.C.; Vitruvius, who wrote about two hundred years later; and Pliny and Dioscorides, who filled respectively the records of the two succeeding centuries. These writers all agree in stating that white lead was produced by placing sheets of lead in pots with vinegar or wine lees, and allowing them to stand. This fails to account for the presence of the carbon dioxide necessary to the reaction which converts the lead acetate to the carbonate; but it is certain that this substance was present, for the product was unquestionably white lead. During the dark ages, and up so far as the sixteenth century, there was but little use for white lead. About the latter date its manufacture was begun in Holland by what is now known as the "Dutch process." This process, however, can scarcely have been original with the Dutch, since Theophilus, a monk who wrote about the tenth century, describes it very exactly, and the Saracens, Italians, and Spaniards are all said to have used it. With the addition of stable litter banked around the jars, in which small bits of marble are also placed, the Dutch process differs in no way from that described by Pliny, who says: "The lead is thrown into jars filled with vinegar, which are kept closed for ten days; the sort of mold which forms upon the surface is then scraped off, and the lead is again put into the vinegar until the whole of the metal is consumed."

William P. Thompson

The Dutch process, whether it dates from Amsterdam or Rhodes, has ever since, however, been the one which, in its elemental principles, but with improvements and technical modifications from time to time, has proved the best and most profitable. Holland became skilled in this manufacture, and England had already established it firmly upon her own tight little island at the time when the century under discussion opened. America, on the other hand, had not one establishment for the manufacture of white lead. What white lead was used during the eighteenth century came from England; but the primitive habits of the community in those early days caused paint to be regarded not only as a luxury, but, furthermore, as a useless one, since timber was far too plentiful and cheap to require preservation at the expense of paint. Neither inside nor out were the buildings of the early colonial townspeople painted, and the log cabins of the settlers needed little such adornment. After the Revolution, however, more luxurious customs and greater pretensions were indulged in by the citizens of the new Republic, and the use of paint became general in the cities. For the body of this paint all the white lead had to be imported from England. The English product at this time was most unblushingly and heavily adulterated, and prices were more than high. So great did the demand become, and so profitable the business to the English manufacturers, that when the manufacture of white lead was proposed and commenced in the United States, the most desperate attempt, resorting to means beyond even the lawful limits, was made to ruin the new American industry. Had it not been for the War of 1812 and the consequent shutting out of British goods, it is highly probable that the white-lead industry would have been delayed for many years in this hemisphere.

The original manufacturer of white lead in the United States was Samuel Wetherill, of Philadelphia, who was also one of the earliest woolen, cotton, and general chemical manufacturers. This enterprising gentleman, who was one of the most prominent members of the Pennsylvania Society for the Encouragement of Manufactures and the Useful Arts, which was established in 1787, began the manufacture of white lead early in the present century. Concerning the exact year authorities differ, —some so widely as to place it in 1789,—but Mr. Pulsifer, to whose "Notes for a History of Lead" I have before referred, takes the authority of a descendant of Mr. Wetherill, and dates the first lead manufactory in the United States from 1804.

Shortly after the factory was opened a young Englishman applied for work. A night or two later the factory was destroyed by fire, and the young Englishman left that very morning for England. Gossip always connected the two events. About 1809 the factory was rebuilt, and then began the bitterest struggle any two great commercial interests here and in England ever waged. British lead was put on the market at a price that was absolutely impossible for the American maker to quote. The War of 1812 saved Wetherill from ruin, and under the impetus thus given the industry grew rapidly for a few years, its growth being still further aided by the development of the recently acquired lead regions that Louisiana, as purchased from the French, included. By the census of 1810, Wetherill's factory, which was the only one in the country, was credited with an annual product of 369 tons. Red lead was also produced in small quantities, but the imports of these two products exceeded the domestic production as two and one half to one. In Philadelphia, where the industry began, the second factory in the country was started by John Harrison, at the Kensington Works, about 1810. In the latter year the manufacture of white lead was begun at Pittsburg by Adam Bielin and J. J. Stevenson. A second factory in the same town was started, but proved unsuccessful after a year or two. Meantime an Englishman named Smith appeared in Philadelphia as a manufacturer of white lead, and all five of these firms were struggling against the English manufacturer when the War of 1812 came to their relief.

All of these early manufacturers employed, so far as can be learned, the Dutch process, as previously described. Certain patents for improvements upon it were taken; but the burning of the Patent Office has destroyed all record of them, except that Samuel Wetherill devised and secured a new and better method "for setting the beds or stacks." Stable litter as the source of the required heat was in universal use. Various new and speedier methods for the manufacture of white lead than those provided by the Dutch process were invented, and in 1814, Welch & Evans, of Philadelphia, patented one by which granulated lead, placed in revolving lead-lined barrels partly filled with water, was ground by attrition, oxidized by the air, and carbonized by the addition of burning charcoal. A factory for the manufacture of lead by this process was built soon after by a Mr. Richards, who had succeeded the Englishman Smith. The venture, like all similar ones, proved unprofitable.

The price of white lead before the War of 1812

was from ten to twenty cents per pound. American manufacturers mainly used the imported pig-lead, and the domestic supply was small. When the importation of the foreign pig-lead was suspended by the war, the price of the native metal took a great jump. The Western lead-fields, however, were either undeveloped or, as in the case of the rich Galena district, still in the hands of the Indians; and a great scarcity of the metal resulted, which caused the price of white lead to advance to thirty cents a pound. The profit inevitably suggested by these figures, together with the general resumption of business that came after peace was declared, gave a fresh impetus to the white-lead industry. During the next twenty years many new works were established, and older ones extended. By 1830 there were twelve establishments in the country, of which eight were east of the Alleghanies. These factories were not turning out over 3000 tons annually, and as the price of white lead, following a temporary glut of the pig-lead market, had declined to nine cents per pound, the total value of the year's output was but a little over $500,000.

One of the great advances made in the manufacture of white lead in this country came about two years after this, when Augustus Graham, a prominent New York manufacturer of white lead, discovered, by obtaining employment as a common workman in one of the great English factories, the secret of the use of spent tan-bark instead of stable litter as a means of obtaining heat and carbonization. This knowledge worked a considerable change in white-lead manufacture, and by 1840 the annual product had increased about sixty-six and two thirds per cent. in the whole country. Prices, however, had advanced but little, white lead being quoted at only a cent a pound more than in 1830. The sudden bursting forth into prosperity and productivity of the mines in the Galena and Missouri lead regions, which occurred during the fifth decade, had an immediate effect upon the white-lead industry. The supply was unlimited, but the question of transportation was a serious one. Waterways were, of necessity, considered the only freight routes available, and Europe was far nearer to the Eastern cities than those towns situated to the westward of the great bar of the Alleghanies. From the Missouri lead-fields, and the Galena region as well, the pig-metal was boated down to New Orleans, and there transhipped by vessel to New York. Not only was it a long journey, but it was a costly one as well; and in some sections, not readily within the distributive field of New York or the large coast cities, other means were adopted. At Buffalo, especially, I recall the method of transportation by which the Galena district pigs were landed at the factories of the corroders. The manufacturer had to keep an agent at the mines, and buy daily, as auctioned off, the product of the day's smelting. When an agent had thus purchased a sufficient quantity he secured a caravan of prairie-schooners drawn by oxen, and started it across the open prairie to the nearest settlement and lake port, Milwaukee, where the lead was shipped in sailing vessels and taken to Buffalo.

The ten years preceding and those during which the Civil War was raging marked no important advance in the lead industry. The introduction of the manufactured zinc oxide as a substitute for white lead, together with the advance in the price of metallic lead under the strong influence of the wartime demand, checked the use of the manufactured product until the return of better times at the conclusion of the war. Furthermore, adulteration, which had long been regarded as permissible by white-lead makers, came to the condemnation it deserved, and the purer product developed by this sentiment had its immediate effect in raising the manufactured lead in the public estimation. It was about this time, also, that "sublimed lead" came to be introduced for use as a substitute for white lead. The discovery resulted from certain unsuccessful experiments made by two gentlemen named Lewis and Bartlett, in the direction of an improved and speedier process for manufacturing white lead. It is a singular fact that the manufacture of white lead is one of the few of the useful arts in which modern science has so far been able to make little appreciable advance. The monkish presbyter Theophilus, in the ninth century, knew, as did the Rhodians before him, and the Dutch nearly seven hundred years after him, the basic principles of the manufacture of white lead; and if the empirical knowledge of that early day has been replaced by formulated knowledge, it still has accomplished but little to recompense its added learning. Englishmen, Frenchmen, Germans, and all other nationalities have experimented with the subject abroad, and Americans have invented and patented at home, but all to no purpose. The original Dutch method, with certain improvements in detail and manipulation, seems destined to survive this century, as it has the many before it.

The white-lead production of the United States, as followed by decades from 1810, while it can only be given for much of the time in approximate

amounts, is still sufficiently exact to show the steady growth which has brought it to prosperity and prominence in the industrial affairs of the nation. As accurately as can be obtained, the figures are:

WHITE-LEAD PRODUCTION, 1810 TO 1890.

YEAR.	TONS.	YEAR.	TONS.
1810..........	369	1860.........	15,000
1820..........	...	1870.........	35,000
1830..........	3,000	1880	50,000
1840..........	5,000	1887.........	65,000
1850..........	9,000	1890.........	75,000

The lead oxides, of which a considerable quantity is annually produced in the United States, were, like white lead, first manufactured in the western hemisphere at Philadelphia, where, before the War of 1812, there were at least three establishments. Their manufacture has changed little during the last one hundred and fifty or two hundred years, during which time they have been recognized products of the English factories, and have also been made in Holland, and to some extent in France. In making red lead, which is, perhaps, the most important of the oxides, the method is simply to heat litharge in a reverberatory furnace, which immediately changes it from yellow to red. In this country this method is the one commonly employed, although some works substitute a bottle-shaped iron cylinder for the reverberatory furnace. Red lead and litharge are usually manufactured at the white-lead works, and there are but few separate establishments for the exclusive manufacture of the lead oxides. Orange mine or orange mineral, a form of lead oxide produced by heating white lead, is another of the useful products of the metal; and the valuable astringent known in medicine as sugar of lead, and chemically as acetate of lead, being obtained by the simple treatment of lead with acetic acid, and without the presence of carbon dioxide, is still another product well known to the commerce of to-day.

The personnel of the white-lead industry since its establishment in 1804 has been an interesting one, and has included many men of the rarest business abilities and most unswerving integrity. For a comprehensive summary of it up to within ten years I acknowledge my indebtedness to the author of "Notes for a History of Lead." According to this authority there were, outside of those firms already mentioned, only two established during the second decade—the Cincinnati Manufacturing Company in 1815, and Barney McLennon's works, in the same city, in 1820. Dr. Vanderberg, of Albany, was experimenting with its manufacture by improved processes in New York in 1820; and ten years later, having come back from experiment to the old-time Dutch process, he, together with David Leavitt and John and Augustus Graham, under the title of the Brooklyn White-Lead Works, were operating successfully. This company was incorporated in June, 1825. Another Brooklyn firm of early establishment was the Union White-Lead Company, started by the Messrs. Cornell about 1827. The Salem Lead Company in 1824, and Francis Peabody in 1826, established the white-lead industry in Salem, and Robert McCandless and Richard Conkling established works in Cincinnati during this same decade. In 1830 there were about a dozen white-lead factories in the United States, and eight of these were east of the Alleghanies, including, besides those just mentioned, Lewis & Company, Wetherill & Sons, Harrison & Brothers, of Philadelphia, and Hinton & Moore, of New York, who also handled large quantities of the imported article. During the next decade there were started the Boston Lead Company, in 1831; Great Falls Manufacturing Company, in 1832; Jewett, Sons & Company, at Saugerties, in 1838; Gregg & Hagner, at Pittsburg, in 1837; and Reed & Hoffman, at St. Louis, in 1837. This latter establishment, taken shortly afterward by Henry T. Blow, became in later years the Collier White-Lead and Oil Company.

From 1840 to 1850 was a period of the most rapid growth for the white-lead industry. Among the larger works established during this decade were: the Atlantic White-Lead Company, of New York, founded by Mr. Robert Colgate; John Jewett & Sons' Staten Island works; the Great Falls Manufacturing Company, changed by Batelle & Renwick to the Ulster White-Lead Company; Suffolk Lead-Works and Norfolk Lead Company, of Boston; the Forest River Lead Company, of Salem, successors to Francis Peabody; Thompson & Company, of Buffalo; B. A. Fahnestock & Company, of Pittsburg; Eagle White-Lead Works, at Cincinnati; and William Glasgow, Jr.'s, works, at St. Louis.

The succeeding decade saw less increase than the one preceding. William Wood and T. J. McCoy took the Eagle Works, of Cincinnati; the Niagara White-Lead Company started at Buffalo, and Wilson Waters & Company at Louisville. This was but a lull, however, that was to give place to renewed activity. From 1860 to 1870 there were founded, among others, such great establishments as the St. Louis Lead and Oil Company, which succeeded the

O'Fallon White-Lead and Oil Company in 1865; the Southern White-Lead Company, established by Platt & Thornburg in the same year; Goshorn Brothers, who secured the McCandless establishment in Cincinnati, and afterward organized it as the Anchor White-Lead Company; the Eagle White-Lead Company, also of Cincinnati; the Shipman White-Lead Company, organized at Chicago by D. B. Shipman; J. H. Morley's works, at Cleveland; Haslett, Leonard & Company, who succeeded Waters in Louisville; Lewis & Schoonmaker, of Louisville, who later sold out to T. J. McCoy and the American White-Lead Company; the Western White-Lead Company, in Philadelphia; the Cornell Lead Company, which succeeded the Niagara Company, at Buffalo; four branch establishments of Fahnestock & Company, at Pittsburg; Hall, Bradley & Company, of New York and Brooklyn; the Salem Lead Company, a new company organized by Mr. Francis Brown at Salem; and the Maryland White-Lead Company, which was established in Baltimore in 1867. In Cincinnati Frederick Eckstein became interested in the business of Townsend Hills.

Since this period there have been comparatively few large establishments founded. Even so early as 1870 the tendency toward consolidation rather than individual extension was already noticeable, and the two largest of the plants founded during the succeeding decade were both absorbed by the older companies.

The manufacture of white lead in former years had been very profitable, which had induced the building of an unnecessarily large number of factories in different sections of the country, which in turn brought on severe competition, and many of the factories became unprofitable. In order to lessen this competition various devices of association were successively tried, and failed, until at last, in 1887, a number of factories came together in an association practically similar to the then existing Standard Oil Trust. The association, however, was unsuccessful, and in 1889 my friends H. H. Rogers and the late Charles M. Pratt, both of whom had had large experience in the lead and paint business, knowing that I was about to retire from my association with the Standard Oil Company, called my attention to the fact that the National Lead Trust were desirous of my becoming interested with them. At that time the suggestions were declined, because of the totally inadequate capital of the existing concerns, the extreme and foolish capitalization, and the disorganized condition of the management. Subsequently arrangements were made by which other great factories of the country, consisting of the John T. Lewis & Brothers Company, Philadelphia; the Salem Company, of Boston; the Atlantic Company, of Brooklyn; the Collier and Southern Companies, of St. Louis, including the Southern Company, of Chicago, and the Maryland Company, of Baltimore, were acquired. These properties came in, necessarily, on the same basis of capitalization as in the preceding organization. The writer then became president, and shortly thereafter acquired the important works of Armstrong, McKelvy & Company and the Davis-Chambers Company, at Pittsburg; and by the end of that year the then National Lead Trust manufactured about eighty per cent. of the country's production of white lead, seventy per cent. of red lead, fifteen per cent. of linseed-oil, ten per cent. of sheet-lead, nine per cent. of lead pipe, and sixty per cent. of lead acetate, together with sundry other of the important manufactures of lead. These, together with the large smelting and refining plant at St. Louis, smelters at Socorro, N. Mex., and Leadville, Colo., and sampling-works in different parts of Mexico, were included in the great organization with which the lead industry of this country entered upon the last decade of the century.

The real work of consolidation, sifting out, and practical organization may be said to have then fairly commenced. Many small factories operating in a desultory way, with frequent stoppages, were closed for good; works in favorable localities, and capable of producing the best results in any one direction, were devoted to this branch, enlarged and improved, and the best class of employees selected and taken to the more important works. New machinery and more healthful appliances were at once put into use. Schools for mutual education among the more important manufacturers were organized, and the expert knowledge of each placed at the service of all.

Efforts to reduce the unwieldy capitalization culminated successfully in 1891, when the Lead Trust was dissolved, and a new company, organized under the laws of the State of New Jersey, with a capital of $15,000,000 preferred and $15,000,000 common stock, took its place. Before the organization of the National Lead Company all the floating debt of the various corporations included in it had been paid off, and soon after its organization the large mortgages which had existed upon some of the works were liquidated, and the National Lead Company enjoys the unique position of never hav-

ing borrowed a dollar. Economics have been introduced in every department, and the character of all manufactured products marvelously improved, and at the same time placed upon the market at prices lower than ever before known, and the fact demonstrated that honest management in a combination of interests is of greater advantage to the shareholder for profit, and to the public for cheapness, than an unintelligent system of piratical competition. With practically the same methods as those employed by the ancients, the industry has risen, through the sheer executive intelligence of the present age, until it has assumed the proportions seen to-day. Less than a century old, the lead industry in America ranks with that of any nation in the world; and from our boundless mineral resources will probably some day be drawn the greater part of the world's supply.

W. P. Thompson

CHAPTER LXV

THE SALT INDUSTRY

THE early history of salt making in this country is veiled in much obscurity. The principal centers of population on the Eastern coast were in great measure supplied with the article imported from England, the price of which was exorbitantly high, and during times of disturbance with the mother country was almost unattainable. In the early part of the eighteenth century small saline plants were established along the Atlantic coast from Massachusetts to Virginia, and salt was made directly from the water of the sea, either by direct open-air evaporation in broad vats, or in smaller kettles with the aid of artificial heat. Fortunately fuel was plentiful and cheap, and, as the process was simple in the extreme, special experience and skill were not requisite. Almost every family, therefore, on the seaboard was its own salt maker, just as, within the writer's recollection, people residing at a little distance inland were their own soap makers and candle makers.

While those living on the coast could always obtain sufficient salt without difficulty, the settler advancing westward could not carry with him a very abundant supply, owing to his lack of capital and of means of transportation. As he penetrated the wilderness, however, he came in contact with the Indian and the beast of the forest, to whom salt was just as necessary as to civilized man. From them he soon learned the sources of their supply, and, locating at one of the "licks" or brine springs, set up his kettle, poured in his brine, and lighted his fire. In a short time he could thus prepare a supply of salt sufficient for his needs during several months. These brine springs were found at various localities in nearly all of the Middle and Western States invaded by the early settler, but none of them was as rich in saline constituents or as ample in supply as those which were found in the country of the Onondagas.

Upon the coast, salt making, by both solar and artificial heat, was extensively practised until after the War of 1812. The restrictions on our commerce being then greatly relieved, salt from foreign countries was more freely imported; and this, together with increasing supplies from the Onondaga district, led to the reduction in price to fifty cents per bushel, and even less. It was then found cheaper to buy the salt from merchants than to continue its manufacture in the primitive manner at the coastwise stations. These, then, were gradually abandoned, and the Eastern and Middle States obtained their supply almost exclusively from the two sources above mentioned. This could hardly be otherwise when we consider that the water of the ocean contains only about two and one half per cent. of salt, as against the brines of the Onondaga salines, which held in solution from fifteen to seventeen per cent. of the precious substance. With salt selling, at the present time, for six or seven cents a bushel, the use of the word "precious" in such connection may seem extravagant; and yet salt, absolutely essential as it is to human life, has been in former times and among certain peoples the general unit of value, and has even, further, served the purposes of a circulating medium.

The American salt industry proper dates back to just beyond the last decade of the last century, when the State of New York, with enlightened foresight, purchased in 1788 from the Indians the Onondaga salines, embracing an area of about 15,000 acres. In the winter of 1789 and 1790 Nathaniel Loomis made 600 bushels of salt on the State reservation. Others followed, and in 1797 the State deemed this infant industry of sufficient importance to put in force laws and regulations regarding the control and management of salt making in this field, a Superintendent being appointed to see that they were properly carried out. During the first year the product

of this field amounted to about 25,000 bushels, equal to 700 tons, of 2000 pounds each, of what is now graded as common fine salt.

The general arrangement made by the State with salt makers was to lease them the ground, on which the lessees erected the necessary structures. The State then pumped the brine and delivered it to the boilers, who paid a royalty of one cent for every bushel of salt obtained from the brine. Even with the early methods of salt making then in vogue (chiefly boiling in kettles) the manufacture was very profitable, and many were induced, on this account, to undertake it. This led to the rapid development of the field, and a corresponding increase in the output, which as early as 1820 amounted to about 13,000 tons. At about this time it is stated that the manufacture of solar salt was commenced on the State lands; but I fail to find any estimate of the quantity produced until 1841, in which year 6000 tons of solar and about 87,000 tons of the other grades were accounted for to the State. The production of salt steadily increased until 1862, when it amounted to about 56,000 tons of solar and 200,000 tons of other grades. From this time there was a gradual diminution in the product of fine salt, which altered the proportions theretofore existing, until in 1880 84,000 tons of solar and about 155,000 tons of other grades were being made. Since 1880 there has been a further falling off in the output, and the official figures for 1894 indicate a production of about 66,000 tons of solar and less than 25,000 tons of other grades. The seemingly immense output of the Onondaga or Syracuse district would doubtless have become still greater had it not been for the development of a field in Michigan, which soon surpassed its older rival in the amount of its output, and materially restricted the territory in which the latter could compete to advantage. The second important blow given to the Onondaga industry was the development of the western New York salt-field, in Wyoming, Genesee, and Livingston counties, embracing what is known as the Warsaw and Genesee districts, the latter being in Livingston County and bordering on the Genesee River. In these districts salt of various grades is made by evaporating the brine with artificial heat, the amount of solar salt being insignificant. As an offset to this, four large shafts have been sunk, three in Livingston and one in Genesee County, from which immense quantities of salt have been brought to the surface in lumps or blocks, some of which are reduced by grinding to smaller sizes. The output of this field increased from 16,000 tons in 1885 to 324,800 tons in 1893. The evaporating-works in western New York possessed a great advantage over those near Syracuse, as they were able to obtain brine holding from twenty-three to twenty-five per cent. of salt, which in practice meant that two tons of fuel would produce as much salt there as three tons would at Syracuse. As a partial offset to this, Syracuse, by its location on the Erie Canal, was enabled to transport its product to the seaboard more cheaply than its rivals. Despite this slight advantage in freight rates the fine salt industry at Syracuse has been obliged to yield the field to competitors in other places, and with no present prospect of revival in this branch of its trade.

The Michigan salt-fields, which were the second of any importance to be developed, possessed the very great advantage of cheap fuel, using, in most cases, sawdust, chips, slabs, and other refuse from the lumber-mills. The first salt made in Michigan on a commercial basis was in 1860, and during the last half of that year 560 tons were made. This was increased in 1861 to nearly 18,000 tons, and the output gradually augmented, until the maximum point (about 550,000 tons) was reached in 1887. Since then there has been a somewhat lessened product. Besides the Michigan fields there were other important regions discovered in the West. The Kansas field was opened with a product of about 22,000 tons in 1888, increasing to 178,000 tons in 1893. In California the product, which was almost wholly solar salt, increased from 30,000 tons in 1886 to 41,000 tons in 1893. During the last two years, however, finer grades of salt have been manufactured in that State. In Ohio there are several salt plants, the principal one of which, at Cleveland, enjoys exceptional facilities in the way of cheap water transportation for its product. The output of the State for 1893 amounted to about 70,000 tons. In Utah the production of salt increased from about 15,000 tons in 1883 to nearly 200,000 tons in 1892, dropping back in the following year to about the output of 1883. This was due to the shutting down of the silver-mines, which had drawn their supply of salt from this district.

The development of the salt industry in Louisiana reads almost like a romance. About eighty years ago, a Mr. Marsh, desiring to obtain a well of fresh water on an island of his, known as the Petite Anse, after digging a few feet, found instead a well of brine. By evaporating this he obtained considerable salt, and upon exploring his possessions farther he discovered a bed of rock-salt about fifteen feet beneath the surface. This salt was mined in the usual way, and

as the surface of the rock was further exposed, various aboriginal relics, such as stone axes and other implements, were brought to light, showing that the same mines had been worked hundreds, perhaps thousands, of years before. The Louisiana salt deposit has never been an important factor in the American trade, except during the War of the Rebellion, when the Confederate States, shut off from purchases in the Northern market, drew largely on these mines, running the price up to $30 and even $90 a ton. At the present day it probably does not command over $2. During the past ten years the annual output of the Petite Anse mine has varied from 25,000 to 50,000 tons. In addition to those above mentioned there are a few other localities in which salt has been manufactured on a commercial scale, but the output is too limited to demand separate mention. The United States reports give the total production of salt for the year 1893 as 11,816,772 barrels, equivalent to 1,654,040 tons; but in my judgment New York is credited with 1,000,000 barrels more than the facts will warrant.

Salt is obtained in this country in several different forms and ways. From the mines it comes in blocks, and from strong brines it is obtained by evaporation or boiling by solar or artificial heat. Boiling is conducted under four distinct systems: (1) in long wooden troughs containing steam-pipes (these are called grainers, and the system is distinctively American); (2) in large open pans of iron or steel, with direct heat beneath them; (3) in large vacuum pans in which the brine is boiled at a comparatively low pressure; (4) heating in closed tubes, at a temperature much higher than that at which brine boils under ordinary atmospheric pressure. As the writer is a manufacturer using two of the above-named systems, he deems it improper in this place to comment on or discuss the merits of the methods adopted by others. Boiling in kettles was at one time an important feature of the Syracuse field, but has never been generally adopted elsewhere.

The grades of salt prepared for market in the United States comprise rock, solar, common fine, and common coarse, which are not artificially dried after manufacture; and so-called "dairy" salt, which is dried and either sifted or ground. The term "dairy" salt is generally used in too comprehensive and loose a sense, and is made to include salt prepared for table use rather than for the dairy. A strict dairy salt specially prepared for the use of butter and cheese makers is the most expensive grade manufactured, selling for a little over half a cent a pound at the works, and costing the consumer about one cent a pound, including package, at most points east of the Mississippi River. For table use this price seems too high, for neither merchant nor consumer will pay it. The greater part of the table salt used in this country is sold by the manufacturers on a basis of about $3 a ton. At $5 a ton there are comparatively few buyers, and at $10 a ton (half a cent a pound) there are none. (These are car-load lots, free on board, and exclusive of the cost of barrels, sacks, or other packages.) This is especially true of large cities like New York and Chicago, while in smaller cities and country towns the merchants are more generally willing to pay higher prices, thereby securing better qualities of the article. For a strict dairy salt there is but little market in New York City, this point not being a distributing center for this grade. Chicago, however, takes large quantities of the best qualities. From that city it is distributed to the large creameries and cheese factories of the West.

The uses of salt are manifold. Many, perhaps, look on it simply as a condiment, or as a preservative of food, butter, cheese, beef, pork, and so on. Its other uses, however, are extensive and important. Hide salting, bottoming of ships (to prevent decay of the wood), acid making (muriatic), and salt-cake (used in the manufacture of glass), soda-ash, bleaching mixtures, soap making, and silver smelting, all make their demands on the salt deposits of the country. The farmer also feeds it to his stock and spreads it on his land.

The salt industry of the United States has had its ups and downs, and history repeats itself wherever a new location is selected for its development. In the Onondaga region salt making was for many years highly remunerative, attracting capital so freely that in course of time upward of 100 firms or corporations made this the seat of their operations. The inevitable result of this was a general fall in prices, the profit on each bushel of salt becoming smaller and smaller. To meet this each operator increased his output to the limit of his resources, thus aggravating the difficulty, until finally it became a question of the survival of the strongest; the only alternative being a combination of all interests under one efficient management. The manufacturers of fine salt solved the problem of existence many years ago by pooling their interests, forming in 1860 the American Dairy-Salt Company. This concern for twenty years or more received reasonable returns on its investments, but when called on to compete with the stronger brines of Michigan and western New York was obliged to yield to the inevitable, and some three years ago these interests were put

Henry G. Piffard.

into the hands of a receiver. The manufacturers of coarse salt at Onondaga in like manner formed a combination, under which their plants are still operated.

In Michigan the vast and rapid development of the territory led to a combination of a majority of the manufacturers, under the name of the Michigan Salt Association, which controlled all sales and fixed all prices. This was well enough until western New York entered the field. The manufacturers of this district wanted the trade that formerly had been supplied by Syracuse and Michigan, and made prices sufficiently low to attract a great deal of it. Not content with this, they entered into the most intense competition among themselves, until the price was brought down so low that some were forced to the wall. Here also attempts were made to harmonize the diverse interests and place prices on a just and equitable basis. Selfishness, dishonesty, and inefficient control rendered these attempts nugatory. Of the Kansas field the same story might be told, and no one field has yet found an effective means of controlling the industry in its own district.

When we consider that any one of the States of New York, Ohio, Michigan, and Kansas is capable of supplying, and desires to supply, the entire country, we need not be surprised that a good article of common salt may be bought at almost any of the manufactories in our country for about $2 a ton. The superintendent of the Onondaga Salt Springs, in his last report to the legislature of the State of New York, correctly expresses the situation in the following words: "The past season has not been remunerative to those engaged in the manufacture of salt." A similar expression could, we believe, be justly employed in connection with the salt industry of the entire country. The Ohio field, with enormous resources in both salt and money, also wants its share of the business. The general outlook for the salt industry, therefore, is not very encouraging. Two attempts have in recent years been made, by drawing in the aid of foreign capital, to consolidate the native salt interests. The first effort failed; and the second, when on the verge of fruition, came to grief in consequence of the failure of certain land speculations in South America.

Foreign competition was for many years held in comparative check by a moderate duty on the imported article. For a little over a year, however, salt has been admitted free. The effect has been a very decided increase of importation and a corresponding decrease of home manufacture. As the domestic prices were already very low, there was very little appreciable gain to the consumer, and some of the works have shut down, and their employees have been deprived of this means of gaining a livelihood. Without having accurate figures on which to base an opinion, I hazard the estimate that about twenty per cent. of our salt operatives have been thrown out of employment, while the wages of the remainder have been reduced by about the same percentage. The sums thus lost to the American artisan have gone in part to the middlemen; and in part to the salt workers of England, the coastwise inhabitants of southern Europe, and the negroes of the West Indies. It may be stated that at the present time the salt factories of England are getting from $2.50 (ten shillings) to over $3 (thirteen shillings) per ton of 2240 pounds for common salt. As the freight from Liverpool to American ports is less than half the freight from the New York State fields to the seaboard, the removal of the duty places our workers at a great disadvantage, and has absolutely compelled the reduction of wages. Comment is needless.

CHAPTER LXVI

THE BISCUIT INDUSTRY

THE history of the biscuit industry in America for the past one hundred years is the story of a phenomenal development from an almost complete obscurity to the wide-spread and well-known conditions of to-day. Perhaps no other single industry is so far-reaching in its sources of supply, or enters into so many homes with its perfected product, as that under consideration. Great difficulty is experienced in procuring early statistics in relation to the biscuit business, as those who were engaged in it during the first part of the century have all passed away and have left no written records. Tradition, therefore, is responsible for almost all our early information.

The name "biscuit," derived through the French from the Latin, means "twice baked," and had, according to Gibbon, its origin in the fact that the military bread of the Romans was twice prepared in the oven. As applied to the product of bakeries, this term was brought from England to America, and came into general use here probably not much earlier than the middle of the century. In Europe all articles of food in the shape of small cakes made from flour, with sweetening or flavoring added, have always been and still are called "biscuits." Goods of this variety, however, were at first unknown in the United States, and the term generally applied to the first crude productions made of plain and unsweetened dough was "cracker." This latter name has ever since retained its significance in this country in connection with the plain, usually crisp, unflavored grades of goods, which last, however, when introduced much later into Europe, were there all absorbed into the generic title "biscuit," the name "cracker" falling into disuse. We have gradually adopted to some extent in America this more sweeping classification, but the distinction between the specific name "cracker" and the general term "biscuit" it is well to bear in mind.

The first cracker produced in the United States, so far as known, was pilot or ship bread, a large, round, clumsy, crisp affair, which supplied the demand of the merchant marine for an article of food that would, unlike ordinary bread, keep for a prolonged period. Subsequently another variety was originated, the cold-water cracker, which differed from the first chiefly in its smaller size, more compact texture, and greater hardness. For a long time these two crackers were the only goods known to the trade. They were both made of unleavened dough (flour and water and a little salt), mixed and kneaded by hand; and each cracker was rolled out and shaped separately before being placed, one at a time, on a long-handled sheet-iron shovel or peel, and transferred in order to the floor of the oval-shaped tile oven then in use. It was not until some time later that raised or fermented dough was used in the manufacture of crackers, and it is only within the past fifty years that any great variety has been produced.

The first cracker bakery in the United States of which we have any trustworthy record was that of Theodore Pearson at Newburyport, Mass., in 1792. His specialty was the pilot or ship bread already spoken of, and in that quaint old town the manufacture is still carried on, the name Pearson having long been a household word in all that part of the country. At Milton, Mass., in 1801, Joshua Bent erected his first oven, which doubtless was a small affair, as it was carried on no more than three days in the week by himself and family, the product then being loaded into his wagon and sold in the surrounding towns. This was the beginning of the baking of the celebrated "Bent's water-cracker," which has achieved a more than national reputation. A little later, in 1805, Artemas Kennedy, a great-uncle of Frank A. Kennedy, established himself at Menotomy, now known as Arlington, Mass., afterward moving to Westford, and finally to Milton. The elder Kennedy died in 1832, and in 1834 one

of his sons, Jason, started a similar enterprise in Charlestown. Jason's cousin, also named Artemas Kennedy, who was his foreman, came in 1840 to Cambridgeport, Mass., and commenced baking for himself. Continued success marked the business until 1861, when Mr. Kennedy died, its conduct devolving upon his son, Frank A. Kennedy.

In Boston the oldest recorded bakery was that of Richard Austin, who started in Ann Street about 1830. He was succeeded by his brother Thomas in 1843, and the business continued under various titles, in which the names of both J. B. Fowle and A. L. Graves appeared at different times, until it came, in 1885, into the hands of J. W. Austin, a descendant of the first Austin, who still carries it on. At a later date came several other firms of prominence in New England, among them Thurston, Hall & Company, of Cambridgeport; John S. Carr, of Springfield; Parks & Savage, of Hartford, Conn.; C. D. Boss, of New London, Conn.; and the New Haven Baking Company, of New Haven, Conn.

In New York City the oldest existing firm is the house of Treadwell & Harris. Ephraim Treadwell, the founder, began business in 1825. About this date, and during the quarter-century following, the firms of Robert Spier, Erastus Titus, John T. Wilson, C. T. Goodwin, J. Bruen, and J. Parr were also in business in the same city; but none of them is now in existence. Later, in 1850, Garrett B. and Edwin O. Brinckerhoff started business on Madison Street, removing, in 1857, to Elizabeth Street, where the Brinckerhoff branch of the New York Biscuit Company is still carried on. At Albany, N. Y., Belcher & Larrabee established themselves about 1860. In 1871 the firm name was changed to E. J. Larrabee & Company, which gained and still maintains a most enviable reputation. Mr. John Holmes, an Englishman, entered their service in 1870, and in 1877 formed in New York City a partnership with G. H. Coutts, under the firm name of Holmes & Coutts. The famous brands of this house at once forced their way to the front, and gave their owners both fame and fortune. A little later J. R. Vanderveer and D. M. Holmes erected, also in New York City, a model establishment, and in a few years made their names recognized as manufacturers of the highest grade of goods.

Meanwhile, following the lead of New England and New York, other bakeries were springing up all over the country. It would be impossible to present any adequate list of these, and the mention of the following more important firms must suffice: Hetfield & Ducker, of Brooklyn; Walter G. Wilson and A. J. Medlar & Company, of Philadelphia; James Beatty (since gone out of existence), J. D. Mason, and J. R. Skillman, of Baltimore; Haste & Harris, of Detroit; the Margaret Bakery, of New Orleans; C. L. Woodman (no longer existing), D. F. Bremner, and the Dake Bakery, of Chicago; Garneau, Dozier & Company (later known as Dozier & Weyl), of St. Louis, and S. S. Marvin & Co., of Pittsburg, Pa. These and many other smaller houses joined in the race for recognition and competed with one another over the country, sending their representatives from Maine to Oregon and from the lakes to the Gulf, besides exporting no small quantity of goods to parts of South America, Africa, and Australia.

Turning our attention at this point to the mechanical processes employed in the manufacture of the goods which the foregoing names represent, we discover in the twenty-five years during the middle of the century a development no less remarkable than rapid. Until about 1840 machinery in the biscuit business was almost unknown, all the goods being worked up and put into the oven one piece at a time by hand. As the demand increased a machine was finally invented which rolled out the dough, already prepared by hand, into a thin sheet. This sheet, passing along on an endless belt or apron, was cut into the required shape by a stamp rising and falling automatically. In this way about a dozen crackers were cut out at a time, and it became possible to bake five or six barrels of flour a day—an important increase over the preceding average rate of one barrel. Except in size and capacity the ordinary cracker-machines of to-day differ but little from the first crude invention. The machines for making fancy goods, however, were of a later date and of correspondingly greater variety, and must not be confounded with those used for making the plain, unsweetened crackers.

In 1849 the discovery of gold in California, and the consequent demand for crackers as a suitable article of pioneer food, proved a marked stimulus to the biscuit trade. Up to about this time the first machines had been turned by man-power. Gradually horse-power and then steam-power were introduced, and the capacity of the various existing plants enlarged. The War of the Rebellion gave a second great impetus to the industry, and the old-time flat-tile ovens being taxed beyond their capacity to meet the increased demand for hard bread for the use of the army and navy, a mechanical reel oven, consisting of a series of long iron pans revolving in a framework, similar in action to the Ferris

wheel, the whole located in a large brick oven-chamber, was invented, and practically revolutionized the cracker business. This change at once caused the capacity of a single oven to jump from the earlier rate of six barrels to twenty-five or thirty barrels of flour a day. The size of these reel ovens has been gradually increased, until at the present time almost all the large plants have a daily capacity of from forty to fifty barrels per oven.

Commensurate with the growth of the business was the increase in the variety of goods produced. In 1840 but five kinds of crackers were known, these being the original pilot-bread, the hard cold-water cracker, the soft or butter cracker, the square soda, and the round sugar-biscuit; the last three differing from the others in containing shortening, butter or lard, and in being the product of a fermented dough. This fermentation or raising greatly increased the lightness and softness of texture of the cracker, and in consequence rapidly met the approval of the public. It will be noticed from the above statement that, with the exception of the sugar-biscuit, no sweet or fancy biscuits were manufactured here at that time. In England, however, fancy cakes of several kinds were on the market; and some years before the War of the Rebellion the two large English firms, Huntley & Palmer, and Peak, Frean & Company, began sending different lines of their fancy biscuit to America. They established agencies in nearly every large city of the Union, even as far west as California, and their goods were sold in all the principal retail grocery houses in the United States. Recognizing the growing importance of this new line of trade, but unable to procure any machinery in this country to supply it, Belcher & Larrabee, of Albany, already mentioned, sent to England in 1865 for the necessary cutters and machines to compete with the foreign imports. Their attempt was successful from the start, and thus began in America the production of sweet or fancy biscuit, which, gradually extending, has become at the present day the most profitable element of the biscuit industry. Shortly after the above date American mechanical skill started into action, and soon H. J. McCollum, of New York, and Denio & Roberts, of Boston, the only prominent makers of bakers' supplies at that time, were equipping the various plants with machinery which, at less cost, rivaled in capacity and operation that of England. In consequence the importation of English goods decreased, and the American varieties, being equally good, almost entirely took their place.

Encouraged by this success at home, several American firms, among them being Holmes & Coutts, Wilson of Philadelphia, and F. A. Kennedy, made an attempt about 1880 to introduce into England and France some of our brands of unsweetened goods; for it will be remembered that in Europe unflavored biscuit—or plain crackers, as we call them—was at that time utterly unknown. For a time this attempt proved successful; but the two large English firms above referred to, finding a growing demand for these new importations, sent men to the United States to study the processes and the grades of flour used here. The result, as may be expected, was but the complement of their earlier experience with their own specialties in America. The English ovens soon produced all the grades of common crackers exported from here, and the American trade, in consequence, declined. Nor has it been possible since that time to revive it to any great extent, owing to the almost prohibitory competition of foreign cheaper tin packages in which the goods must be placed to be shipped, and cheaper labor. American goods are, however, still exported in medium quantities to Africa and South America, while in many of the large cities of Europe some of the specialties of a few firms can be found.

Glancing over the development of recent years, we see a progress and a growth that it is almost impossible to analyze. Originative skill and strict business application have produced machine after machine and established system after system, by which the industry, though perhaps still somewhat short of perfection, has reached a high rank in the scale of magnitude and efficiency. A great many of the processes involved have been practically revolutionized, in almost all instances machinery taking the place of the former hand labor. As an instance, the dough, which until twenty years ago was mixed and kneaded by hand in long boxes, is now entirely prepared in large iron mixers by means of a revolving paddle, some of these machines being capable of handling as much as twelve barrels of flour at a time. Machines, also, to produce an almost endless variety of fancy cakes and biscuits have been invented and introduced, resulting in an ever-increasing list of new goods. When Joshua Bent first established his bakery at the beginning of the century only two kinds of crackers were known. To-day the number reaches in the aggregate at least 500 different grades and varieties. Some of the greatest successes in this increase have been the result of accident, while others are the perfection of long and costly experiment. In this connection must be mentioned the names of J. H. Mitchell, of

Frank A. Kennedy.

Philadelphia; Ruger, of Buffalo; H. J. McCollum and Fowler & Rockwell, of New York; and Roth & McMahon, of Chicago, all manufacturers of bakers' supplies and machinery, and each taking a part in the invention and development of the mechanical processes introduced. And the end is not yet. New specialties are constantly being produced by the various competing firms, and the skill and ingenuity of all those directly interested are constantly taxed to bring to life some new combination of delicacies, while a host of artists is kept active in originating attractive and suitable labels and coverings for the various packages in which the goods meet the public. To give some slight idea of the magnitude of the biscuit business as it stands to-day, a few statistics may be of interest. Before giving these, however, it will be necessary to add a short account of the recent organization of the biscuit industry.

In 1890 three large companies were formed, comprising together nearly all the largest and most prominent plants in the country. The first of these, the New York Biscuit Company, includes the leading houses of New England and New York, with an immense factory in New York City, the largest and most complete in the United States. The building is 600 feet long, 200 feet wide, and rises six stories in height. Forty ovens are its complement, with an aggregate daily baking capacity of 1000 barrels of flour. The second is the American Biscuit and Manufacturing Company, with one factory in New York City, but doing its principal business in the West and South. The third is the United States Baking Company, its largest factories situated in Indiana, Ohio, and Pennsylvania. These three companies represent an aggregate capital of $25,000,000, and in 1894 their consumption of flour approximated 1,400,000 barrels. A fourth, somewhat smaller, company, the National, has since been formed, which has plants situated respectively in Denver, Colo., Cedar Rapids, Ia., Des Moines, Ia., Rock Island, Ill., and New Orleans, La.

Although these four companies represent almost all the important plants, it is safe to assume that their consumption of raw material and consequent product is not above one half the total in the United States, for in nearly every large city and town from Eastport to California can be found independent bakeries, each with one or more ovens. In the manufacture of biscuit, flour is, of course, the most prominent item; and the importance of this fact to the farmer can be gauged when we calculate that in order to supply the needs of all the cracker bakeries of this country during the past year at least 2,800,000 barrels of flour were required. Reckoning five bushels of wheat to a barrel of flour, and twenty bushels to the acre, we find that the above figure means the product of no less than 14,000,000 bushels or 700,000 acres. But flour, though the most important, is by no means the only raw material of consequence used in the biscuit business. The following figures are taken from the report for the year 1894, and, though rough, are as close an approximation to the actual amounts of materials other than flour as it is possible to estimate:

MATERIALS CONSUMED IN BISCUIT MANUFACTURE.

51,000,000	pounds	sugar.
1,800,000	gallons	molasses and syrup from the West Indies and our Southern States.
34,000,000	pounds	lard.
6,000,000	"	butter.
400,000	gallons	milk.
1,900,000	dozen	eggs.
1,017,770	pounds	honey from Cuba, Florida, California, and the far West.
2,132,330	"	raisins from the Mediterranean and California.
722,439	"	figs from Smyrna.
22,486,636	"	soda.
1,830,982	"	cocoanuts.
18,748	"	almond nuts.
4,145,004	"	salt.
814,598	"	currants.
408,510	"	ginger.
7,128	gallons	extract vanilla.
564,034	pounds	jellies.
70,764	"	almond paste.
15,936	"	oil of lemon and orange.
230,545	"	chocolate.
73,988	"	cream of tartar.
97,770	"	apricots.
21,306	"	citron.

To these figures must be added the following, which enable the finished goods to properly reach the consumer: 10,000,000 wood boxes; 7,000,000 barrels; tin to the value of $250,000, made into cans and packages; together with 5000 tons of paper and pasteboard. To handle all these materials and prepare the product for market an army of workers is required. For all the heavier labor, mixing and baking, men are employed; but the packing, labeling, and some portions of the fancy or iced work are done by skilful-fingered girls. Traveling salesmen visit every portion of the country for orders, and in the large cities drivers by the hundreds, with handsome wagons, make daily and weekly rounds, supplying the trade with the factory product. The New York Biscuit Company alone has 2500 operatives, besides 350 salesmen and drivers; and the total number of hands engaged in the various processes of the biscuit industry in the United States will probably reach not less than 25,000.

Not a freight-train or steamer of any principal line but carries these goods over the country. Not a yacht skims along our shores, not a vessel crosses the ocean, without carrying biscuit in greater or less variety in its store-room. Not a hotel would think its menu complete without the after-dinner coffee with crackers and cheese. Not a picnic party would arrange for an outing without calling upon the grocer for its supply of biscuit. Not an afternoon tea, luncheon, or other social function would be complete without the dainty novelties so lavishly supplied by our leading bakeries. When we add to this the daily home consumption, and the constantly increasing exports to the West Indies, Central and South America, which are following closely on the growth of political alliances between the American republics, the value and importance of the biscuit industry to the country is appreciated. No field affords better opportunity to intelligence, genius, and business enthusiasm. The century which is closing has recorded great achievements, but that which lies ahead is equally full of promise.

Frank A Kennedy

CHAPTER LXVII

THE COTTON-SEED-OIL INDUSTRY

THE utilization of one waste product does more to enrich the world than an increase of many millions of dollars of product in some old and well established industry. Perhaps there is no single thing that more forcibly illustrates this truism than the utilization of the once despised cotton-seed. In the process of ginning seed-cotton the result is a little more than two pounds of seed for every pound of cotton produced; and forty years ago, aside from the small amount of seed that might be reserved for the next season's planting, and such small quantities as were consumed by the cattle on the plantation, there was absolutely no use to which it could be applied. At the gins the great seed heaps grew, as the sawdust heaps rise to-day around the portable sawmill, until, as a last resort, the gin would be moved from the base of the seed mountain it had reared up to itself. Thus was cotton-seed, in 1840 and 1850, a source of actual expense and an encumbrance. That there was an oil that might be made useful contained in the cotton-seed was known, of course, ever since 1783, when that august and venerable body, the London Society for the Encouragement of Arts, Manufactures, and Commerce, first called public attention to it. The real value of this oil, or a method for its extraction, was, however, not known to the society; and while it declared that the seed-cake resulting from the manufacture of the oil was good cattle-food, and though the society offered gold and silver medals of reward for the first successful process of making the oil and cake, it never had occasion to bestow its honors. Later on, when the seed of the Egyptian cotton was introduced into Europe, the manufacture and refining of the oil was begun and carried on quite extensively. The use of the product for food purposes was also learned abroad before any advance whatever had been made by this country in that direction.

The dilatoriness of Americans in availing themselves of this great wasted asset was undoubtedly due to the fact that the South, where cotton was king, was not a manufacturing community, and had neither taste nor inclination to develop along any but agricultural lines. Her population, further, embraced but few of the operative class needed for the labor of the manufactory. The first recorded attempts in this country to extract the crude cotton-seed oil were made at Natchez, Miss., in 1834, and at New Orleans in 1847. Both were complete failures from the standpoint of practicability, and it was long a lugubrious jest with the late Mr. Frederick Good, of New Orleans, who was active in the second attempt, to show a small bottle of the crude cotton-seed oil, which he stated had cost him just $12,000. Abroad the seed of the Egyptian cotton continued to be used more or less successfully, and experiments —rather desultory in their nature, perhaps—were continued on this side of the water. The greatest difficulty encountered by the pioneers in this field was the total lack of appropriate machinery. Foremost as Americans have been in the invention of mechanical appliances, they were singularly backward in developing machinery for the expression of the cotton-seed oil. At the time now under discussion each mill that was attempted had its own mechanical ideas, and these were uniformly crude and unsuccessful. In fact, the introduction of improved or even fairly practicable methods of extracting and refining cotton-seed oil did not come until some of the American manufacturers—notably Mr. Paul Aldigé, of New Orleans—had visited the great European works, including those at Marseilles, and patterned from them, in the early years after the Civil War.

Prior to this, however, the industry had gained a foothold on a small scale, and crude cotton-seed oil was put on the market in limited quantities. Its appearance as a domestic product dates from about 1855, and to Mr. Paul Aldigé, of New Orleans, later one of the most prominent cotton-seed-oil manufacturers in the country, is due the credit for the first successful attempt at crushing the seed in a mill. He

had to contend with many difficulties, not the least of which was procuring the cotton-seed. The wealthy planters of those ante-bellum days, when their cotton crop was picked, ginned, and baled, were quite disposed to regard the business as completed. To be troubled about selling the waste seed product of the gins was not worth their while; and as the small planter did not exist to any extent, it was more than difficult to secure the needed seed. It was harder to get one ton then than it is to get one hundred to-day. Furthermore, the transportation facilities for bringing in the seed from the outlying districts were of the poorest. These obstacles, together with crude machinery and little knowledge concerning the valuable by-products to be obtained from the manufacture of the oil, all operated to keep the industry at the lowest point.

Singularly enough, it was in the tight little Yankee State of Rhode Island that the first firm foothold for this peculiarly Southern industry was obtained. A mill was started at Providence, R. I., in 1855–56, and the seed was shipped from the South, principally from New Orleans. While but a small affair compared with the huge works of to-day, this mill continued to be operated until the outbreak of the Civil War put an end to Southern seed shipments. During the years of war that followed, the cotton-seed-oil industry made little headway here, although abroad it was rapidly coming into prominence. There were a few small mills and refineries in the cities along the Mississippi, notably at Vicksburg and New Orleans; and after the blockade of that river began to shut off supplies, their product came into demand as an illuminating oil, despite the fact that it could not be burned in chimney-lamps. In the accumulation of the seed-cake resulting from this blockade, which prevented all exportation, the South first came to use it, in default of anything better, as a food for cattle. It had never been used for such a purpose here before, although it had been exported, and its valuable properties were well known on the continent of Europe. The hulls, also, were discovered at this time, in the same forced way, to be good food-stuff for cattle, and their use for this purpose, in a limited way in the South, dates from this time. These hulls, mixed with a certain percentage of the meal of the seed-cake, make a compact form of fodder, and were used in the timber regions and other localities where hay was hard to obtain and difficult to transport.

It is not many years ago that every cotton-seed mill in the country utilized, as far as possible, its hulls for fuel to operate the mills; but this demand fell short of the production, and the larger mills were put to an expense for hauling the hulls away or for erecting furnaces to convert them into ashes. Gradually the value of the hull became known to the dairyman, and then to the feeder of stock for the butcher, till at the present time practically all the hulls produced are utilized as cattle-food, and that which was only lately an expense to the crusher has become a source of revenue.

This and many other most valuable by-products were, however, almost unknown here until after the war had ended. In New Orleans and at Vicksburg the crushing of the seed was continued in a small way during the years between 1860 and 1865, when peace, with the consequent return of the people to their agricultural pursuits, again brought larger crops and increased activity. In 1866 there were in the whole United States just seven mills for the crushing of the cotton-seed. Though the diverse usefulness of the cotton-seed oil was manifesting itself almost daily in some new form, the growth of the industry was comparatively slow. Twenty-six mills in 1870 increased in the next ten years to only forty-five. These represented a capital invested of $3,862,300, through which was turned out an annual product valued at $7,690,921. In wages the cotton-seed mills in 1880 paid out $880,836 to 3319 employees, and the value of the material consumed by them in the processes of manufacture was $5,091,251. These figures, while of respectable amount, considered with due allowance for the short time the industry had been known, still sink into insignificance by contrast with those representing its condition to-day. The fifteen years that followed 1880 have seen the most wonderful change in the status of the cotton-seed-oil business among the commercial and industrial interests of the country. While the total product of the country in 1880 was less than $8,000,000, that of a single concern, the American Cotton Oil Company, ten years later, was over $20,000,000, and 5000 employees were carried on the rolls of this one company.

One of the great factors in this wonderful growth has been the continued bringing to light of new uses and value for the product. What the discovery of the by-products of petroleum did for that mineral oil was done for cotton-seed oil, when the manifold uses of the refined product began to be understood. As an oil, that of the cotton-seed possesses in high degree all the properties common to the best vegetable oils, with the exceptions that for household illumination, or as a lubricant, it cannot be used to advantage. As ordinarily known in

the phraseology of the market, refined cotton-seed oil is of four varieties, viz., summer and winter yellow, and summer and winter white. From the summer yellow are derived many valuable products. The well-known lard compound, "cottolene," and similar products, which have so largely superseded hog-lard for cooking purposes, take a great deal of this grade of oil, the bulk of which, in fact, may be said to be consumed in culinary channels. When cheaper than tallow, "summer yellow" is also used in great quantity in the manufacture of laundry and toilet soaps, and a large amount of it, made from selected crude oil, is exported for use abroad in the making of butterine, a substitute for butter much used in Holland, Belgium, France, and other European countries. This grade of oil is of the finest quality, and in many places has supplanted olive-oil as a dressing for salads or the general uses of the table. Druggists find in it a reliable and excellent substitute for olive-oil in many preparations for external application, such as salves and liniments. Not being inflammable, cotton-seed oil is used by the salt manufacturers to float on top of their tanks, and the paper makers find a similar use for it. By a process of bleaching, "summer yellow" is converted into "summer white." "Winter yellow" and "winter white" will stand a cold test at 32° Fahrenheit, without chilling. These oils are produced from the summer oils by extracting a large percentage of the stearine contained therein. Winter oils are largely used as a substitute for whale and lard oils in miners' lamps, and considerable quantities are used in foreign countries. Cotton-seed soap-stock, as known to commerce, is the residuum of the refining-kettle, and is utilized in low-grade laundry soaps and in wool-scouring soaps.

Besides these uses of the refined oils, the crusher of cotton-seed sees his product and by-products bring him returns from various other sources. The cotton-seed cake, or solid residuum of seed remaining after the expression of the oil, finds sale as cake, principally in Great Britain; but by far the larger portion of the cake is converted, by grinding, into cotton-seed meal, which is of such high repute at home and abroad, both as a food for cattle and sheep and as an ingredient of ammonial fertilizers, that the entire production finds a ready sale. The "linters" or short staple cotton, ranking relatively as of about half-value with "middling cotton," is another by-product which the cotton-seed crusher gains through a careful reginning of the seed.

The process of extracting the oil from the cotton-seed is a rather complicated one in its preparatory stages, but is simplified to the last degree by the employment of machinery at each and every step. The seed, on reaching the mill, is first screened, to remove sand, dirt, bolls, and foreign substances, and finally a draft of air is used to complete the cleaning process. The seed is now ready for the linters, which machines are an elaboration of the ordinary cotton-gin; and whatever staple remains upon the seed is stripped off in passing through them. From the linters the seed passes to the huller, a high-speed cutting-machine, which cuts it up most thoroughly. The hulls, by screens and beaters, are now separated from the meats, which latter are, by screw-conveyers, conducted to bins contiguous to roller-crushers, and as fast as required are passed through the crushers, where the mass is reduced to a uniform consistency, and is known to millmen as "uncooked meal." The first step is cooking this meal, which is done in steam-jacketed kettles. When heated to a proper degree the meal is drawn from the kettles, formed into cakes, enveloped in camel's-hair cloth, and placed in boxes of an hydraulic press, when by the application of proper pressure the crude oil is speedily extracted. The solid residue remaining in the press-box is the decorticated cotton-seed-oil cake of commerce.

In the practical methods by which these mills are supplied and operated all the improvements of modern industrial enterprise have been laid under tribute. In the distribution of the oil product, tank-cars on the railroads and tank-steamers on the high seas are used for transportation in bulk; and the American Cotton Oil Company, in its immense export business to Rotterdam, has a tank-steamship capable of carrying 4200 tons of oil in bulk, thus saving the heavy item of cooperage. This steamer can thus carry, without injuring, even the finest quality of the food-oil, which is in great demand in Holland and Belgium. As an evidence of the amount consumed there it is shown that Rotterdam alone imported in one year, recently, no less than 8,356,676 gallons of cotton-seed oil, of which 5,973,760 were from this country. The diversity of the industry requires factories other than the crude-oil mills, as refineries, lard and cottolene plants, soap factories, cotton-ginneries, cotton-compressors, and fertilizer-mixing establishments. The supply for all these is derived directly from the crude-oil mills, which in their turn are operated immediately from the raw material, in providing which there has grown up a most important branch of the agricultural system of the South.

With the development of the industry in later

years have come, of necessity, radical changes in the methods of collecting the seed and covering the country. The commission-merchant, who, in the early days after the war, did almost all the business for the large cities, has disappeared. With New Orleans as a center for the large milling interests, these seed buyers formerly laid only the Mississippi River bottoms under contribution for their annual supply. They acted as middlemen, and to them the mills sent as many bags as they desired to have filled for their season's supply. These bags were in turn sent out by the agents to the planters to be filled, and on their return were forwarded to the mills, where they were reweighed, inspected, and, if found defective in any way, a charge was entered against the commission-merchant, who was furthermore responsible for the bags, and was duly charged with any shortage of return. As the mills increased, however, and competition became keener, buyers from the various great concerns supplanted the commission-merchant. They represented their particular mills, and scoured great districts of the cotton-growing sections, hundreds of miles distant, buying up all the seed they could find. This arrangement entailed upon the mills the necessity of direct dealing with the planters, which sometimes has resulted in more or less pecuniary loss. Where twenty-five years ago the commission-merchant stood between the mill and short weight, poor-quality seed, or shortage in the bags, there is no one to do so to-day, and the petty losses in the individual dealings make up an aggregate sum that adds materially to the annual expense account.

As collections are now made, everything has been systematized to a point that insures the greatest possible expedition of business. In the small inland towns the seed is brought in entirely by wagons, drawn by the inevitable Southern mule; and every Saturday morning during cotton-picking time a long string of these wagons can be seen waiting in the sun outside the seed depot to be weighed and unloaded. All is grist that comes to a cotton-seed buyer nowadays; that is, until he begins to grind. Foreign substances and poor-quality seed mix with the wagon-load, and are shoveled in to him at the same market price as the good product. He has no time to object, as the early cotton-seed grinder would most certainly have done. He now knows the machinery in the mill will sort all that mass of seed as intelligently as he himself could do it, and with infinitely more rapidity. He knows that he and his colleagues are now buying from 1,250,000 to 1,500,000 tons per year, where a few thousands only were bought twenty-five years ago, and if the expediting of this vast business involves some increased expense, it must be borne. This buying in bulk is also practised where the seed is transported by rail to the mills. Immense tracts are laid under contribution in this way, and remote districts reached by the mills in their ever-extending hunt for the seed. Much of the product brought in by the railroads is transported for several hundred miles, and statistics place the average expense to the mills of this single transportation item at $2 per ton, which, supposing that only one half the total seed-supply was carried over the railroads, would run into large figures.

The third and most favored method of collecting the cotton-seed is by boat along the rivers. In this form of collection it is found necessary to sack the seed, and for this purpose the mills supply the bags. A steamboat carrying several thousands of empty bags will leave New Orleans or Vicksburg, as the case may be, and steaming slowly up the river, stop at each small town and at the various plantations along the levees. At each stopping-place as many bags are left as each planter thinks he can fill; and when the last bag has been given out, the steamboat is turned and headed down the river to pick up the freight by the dozen or by the hundred bags as it returns. The great drawback to this system is that the bag used for cotton-seed is altogether too popular an article among the planters. These "planters" are not the class of men they were in the old ante-bellum days. The glory of the manorial residence, with its broad acres, has departed, and the name has ceased to signify anything more than an ordinary farmer. The planters to-day are small holders, and for the most part negroes, to whom a cotton bag has a varied utility that would scarcely be believed at first sight. It makes an excellent pair of trousers or a coat for plantation work, a good saddle-cloth for the road, and can even be found as bedding in not a few of the houses along the levees. That the loss entailed in this seemingly petty way is really a heavy one may be gathered from the fact that the mills have had a shortage of as many as 1,500,000 bags in a single season.

The effect upon the cotton-growing interests of the South of the great industry that has sprung up from this seed has been undoubtedly great. In the face of a declining market the total production of the plantations has more than doubled during the past twenty-five years. A crop of 3,154,946 bales in 1870 had increased to a total production of 7,527,211 bales in 1894. Cotton-seed oil solely, has not been, of course, responsible for this advance,

nor is such a claim advanced. It can be stated, however, that since the small planter, with his five to ten bale crop, became common throughout the cotton belt, the additional revenue which he has been able to derive from the sale of the cotton-seed has done much to aid his progress.

The quality of the cotton affects little or not at all the quality of the seed, and soil so poor as to yield a hardly marketable cotton will still grow a plant whose seeds are as good as the best. In the making of the cotton-seed oil there has already been utilized a large amount of the seed of the almost worthless "bumblebee" cotton. This cotton is stunted, either from poor soil or lack of cultivation, and grows so near the ground that only the very smallest negro children, known as "bumblebees," are able to pick it without becoming exhausted by stooping. Finally, when it is considered that the seed of the cotton-plant more than pays the entire expense of ginning, baling, and tying the crop, the economy it effects is plainly seen. Even the slave labor of the ante-bellum days cost its own maintenance, and, little as that cost was, the financial interests of the plantation to-day are better served because of the added value of the seed. In fact, the whole agricultural life of the South has been benefited by this formerly despised gift of old King Cotton, and it is only just to say that the people are becoming appreciative of this fact.

To return to the history of the industry from the point at which we left it in 1880. The fifteen years which have intervened between then and now have formed the period in which cotton-seed crushing may fairly be said to have taken its place among the great American interests. Forty-five mills in 1880 had increased to sixty within two years, or at the rate of thirty-three and one third per cent. Since then the increase has been steady, both in the number of mills and in the capacity of those already in operation. In 1890 there were 119 establishments, and it is a small mill nowadays that does not crush 10,000 tons of seed during the season, although twenty years ago such a capacity would have been looked upon as enormous.

Looking back upon the cotton-seed-oil industry for fifteen years, the personnel of the trade gains an added interest and a deeper significance viewed in the light of later events. Few of the men who were looked up to as leaders in the business at that time are leaders to-day. Many are dead and all are changed, but they are still remembered as pioneers in the days of the early successes of cotton-seed crushing. The babe is now become a giant, both at home and abroad. The prejudice against cotton-seed oil—so rampant fifteen years ago as to induce Spain at that time to begin a war against its importation, in which Italy, moved to the defense of her olives, speedily joined—has largely disappeared. Since 1889 the exportation of cotton-seed cake and meal has become an important item of our foreign trade, and one which bids fair largely to increase. The amount exported in 1893 was 195,319 tons, and in 1894, 208,042 tons. In addition to this the exports of cotton-seed oil in 1894 amounted to 14,958,309 gallons, valued at $6,008,405.

In the year 1894, with a cotton crop of nearly 8,000,000 bales, there were over 1,500,000 tons of seed crushed. This means that at least $10,000,000 were distributed among the planters of the South in cash payments for cotton-seed; the railroad and transportation companies received as much more in freights. From this resulted a product approximating 60,000,000 gallons of crude cotton-seed oil, besides about 500,000 tons of oil-cake and meal. Wages and the legitimate expenses of the industry further circulate millions annually. Its prosperity reacts beneficially upon the country, and its product adds to the comfort and conveniences of the time. With it the South takes her place among the other sections in the manufacturing interests which will bring wealth to her and commercial honor and credit to the American nation.

CHAPTER LXVIII

THE STARCH INDUSTRY

STARCH is a white pulverulent substance composed of microscopic spheroids, which are, in fact, sacs containing amylaceous matter. These microscopic particles vary in size and form, and exist in many plants. Chemists name three kinds of starch—one found in cereals, another called inulin, and a third called lichen-starch. They are all insoluble in cold water, alcohol, ether, and oils, and, with the exception of inulin, are converted into sugar by dilute sulphuric acid and by diastase. The first-named forms with hot water a mucilaginous solution, which, when cold, is the starch used by the laundress of to-day; it is tinged blue by iodine. The second forms a granular precipitate when its solution in boiling water is allowed to cool, and is tinged a fugitive brown by iodine. The third, by cooling the concentrated solution, gives a gelatinous mass, with clear liquid containing very little starch floating over it; its jelly becomes yellow with iodine. Starch is found in wheat, rye, barley, oats, buckwheat, rice, corn, millet, pease, beans, potatoes, arrowroot, and other plants, and varies greatly in quantity under different circumstances.

The making of starch had a very ancient origin, for it is spoken of by Pliny, in the first century A.D., as being made from wheat on the island of Chios. Very little is said of it by modern writers, however, until the time of the reign of Queen Elizabeth, when its use became almost a necessity for stiffening the enormous ruffs worn by the queen and her court. So scarce and exclusive was the article at that time that its use was forbidden by English law except for the purpose just mentioned, and by perfumers in making the hair-powders then in vogue. The Greeks made starch from wheat for food about the beginning of our era, and potatoes formed a considerable source of starch-supply early in the sixteenth century.

As the manufacture of cotton goods increased, and especially after the development of calico printing, there was a greatly enlarged demand for starch, and as the early restrictions upon its manufacture were removed, inventors and experimenters turned their attention to its cheaper and better production. Crude methods for making it became generally known, and it was produced in small quantities in many families for home use. New sources of supply were also discovered, and gradually took their proper place in the general economy of the industry. The importance attaching to these is indicated by the fact that in 1796 the British Society of Arts gave a medal to Mrs. Gibbs, of Portland, for her discovery of *Arum maculatum* as a source of starch. But for many years the principal source of the article was wheat or potatoes.

One hundred years ago there was not a starch factory in all our broad land except the domestic ones, where our great-grandmothers grated the potato and washed the starch out of the pulp. This was then strained and left over night to settle; in the morning the water was poured off, and the starch removed from the vessel and dried in the sun, being then laid aside to be used as occasion required. The oldest process of manufacturing wheat-starch in the United States consisted in steeping the grain in water until it was soft, when it was passed through a malt-mill, or between rollers, and again mixed with water. Fermentation then set in, forming lactic and acetic acids, which disintegrated the cellular structure of the kernel and liberated the starch granules. These were collected by repeated washings and precipitations, the process being continued several days, the gluten putrefying and giving off a very foul odor. The sugar and a portion of the starch were converted into alcohol, and a part of this into lactic and acetic acids, which dissolved the gluten that had escaped putrefaction. Thorough washing removed the soluble matter, and the starch left behind was dried and prepared for market. The other method, known as non-fermenting, is of French origin, and consisted in kneading wheat-flour into dough with water, and then

THOMSON KINGSFORD.

washing in a fine sieve in a stream of water as long as the passing water continued milky. The starch in suspension and the sugary portion in solution were caught below the sieve, and the gluten nearly all remained behind in a sticky mass. What passed through was left to ferment twenty-four hours in an oven at 68° Fahrenheit, and a little leaven was added, or the skimmings of a former operation, to hasten the process. The portion of gluten carried through with the starch was thus separated and recovered by skimming. The starch was then treated like that otherwise produced. This last-described method gave a product of about fifty per cent. of the weight of flour, while by the first process it was only thirty-five or forty per cent. Most of the gluten was saved in a condition to be used for food by mixing it with potato or other substance. The starch thus produced, while good for some purposes, lacked the required strength for fine laundry-work, was not clear and pure white like the modern product, and, being made from wheat, was comparatively costly. The removal of the gluten was never perfect, causing endless annoyance and perplexity to the laundress when it came in contact with her hot irons; and it was by these, or still more crude and costly methods, that nearly all the starch was produced down to about the year 1841.

The uses to which starch is put are numerous. Not only in the laundry and kitchen do we find it, but also in many of the leading manufactories of the day. It is used largely in the manufacture of textile fabrics, in calico printing, paper, confectionery, breadstuffs, paint, wood filling, etc.

The manufacture of starch from potatoes in this country is now confined principally to the New England States, Maine having forty-four factories. There are sixty-four factories engaged in this branch of the starch industry of which I have knowledge, these factories consuming 2,824,512 bushels of potatoes, producing 24,008,352 pounds of starch per annum, requiring 1536 horse-power, and employing 659 hands for about three months in each year. The capital invested is $355,765, and the value of the annual product, $854,697.33. Cull potatoes are largely used. Potato-starch is used almost entirely by manufacturers of textile fabrics.

The wheat-starch industry early in the century gave promise of great importance, the annual output of this commodity continuing to increase until 1842, when the discovery and perfection of the process for the extraction of starch from Indian corn, by Thomas Kingsford, turned the attention of manufacturers to this cereal as a source of starch supply, and many wheat-starch factories were remodeled thereafter to use Indian corn. The first wheat-starch factory of which I have knowledge was that started by Edward and John Gilbert at Utica, N. Y., in 1807, which factory continued until about 1849, when it was remodeled to use Indian corn. The business was given up and the plant abandoned in 1859. In 1817 a wheat-starch factory was started by Thomas Barnett at Philadelphia, Pa., which was removed to Knowlton, Pa., in 1879, and there continues in operation. The next wheat-starch factory was operated by George Fox in Cincinnati, O., in 1824, at which time but five bushels of wheat were consumed in the weekly output. The business gradually increased, until 500 bushels per week were required to meet the demand. This factory began the manufacture of starch from Indian corn in 1854. In 1827 William Colgate & Company started a wheat-starch factory in Jersey City, N. J., where they had a very successful career in this branch of the starch industry. Their plant was altered into a corn-starch factory in 1842, and continued in the manufacture of starch from the latter-named grain until 1865. In 1843 Colgate & Wood (Charles Colgate and Julius J. Wood) began the manufacture of wheat-starch at Columbus, O. There are but five wheat-starch factories in this country at the present time of which I have knowledge. These factories have an aggregate capital of $195,000, the annual production being 8,312,000 pounds, valued at $346,000, requiring 250 horse-power, and employing 88 hands. The capacity of these factories is 1077 bushels of wheat per day.

As early as the year 1841, while Thomas Kingsford was superintending the wheat-starch factories of William Colgate & Company in Jersey City, N. J., where he had been employed since the spring of 1832, he clearly saw the objectionable features of both the methods of manufacture and of the product, and in his study to remove them became convinced that in our ripe Indian corn lay the future source of abundant starch that would in every way excel all others if it could be separated from every substance foreign to its nature. He imparted his conviction to his employers, the result of which may be inferred—manufacturers and capitalists are seldom ready to aid in the experiments of investigators. They thought that, at the best, the prospects of success were doubtful. They were making money, and why should they not continue manufacturing starch from wheat instead of taking up a wild project? He talked with other starch makers of that day, who ridiculed the idea, and declared it to be impracticable and visionary.

Satisfaction with present conditions is always a foe to advancement. The more he thought of the subject the more his mind was imbued with the belief that ultimate success awaited him. The history of his experiments is deeply interesting.

In the year 1841, at the Colgate factory in Jersey City, N. J., he began a series of experiments to test his theory, following substantially the processes in use in the factory. He first soaked a quantity of Indian corn-meal, and then washed it through a fine sieve, hoping thus to secure the starch; but it remained only corn-meal. He then obtained some shelled corn, soaked it several days in lye to soften the grain, and endeavored to reduce the kernels to pulp with a mortar and pestle. This done, he washed out the starch, or endeavored to, from the other constituents; but this attempt also failed. He then tried a wooden screw-crusher, with which, and the use of several solutions, he endeavored to extract the pure starch; but again failure attended him. His next mechanical contrivance for reducing the corn to pulp was a paint-mill, but the final result was the same—he failed to effect a separation of the starch. He then soaked another quantity of corn, and passed it between the rollers of an old sugar-mill, borrowed from a grocer; but the rust on the mill discolored and spoiled his product. Still persistent, he procured a pair of granite rollers, mounted them on shafts in a frame, and by passing the corn repeatedly between them, obtained a clear pulp. When this was strained, washed, and settled by the process with which he was familiar in the manufacture of wheat-starch, he found it so mixed with gluten, albumen, woody fiber, and other impurities, that he could not effect the separation desired. Mr. Kingsford now continued his experiments with various kinds of acid, hoping to produce the long-sought separation of the pure starch from all the other constituents of the grain, but without success. He then made a solution of wood-ash lye, the use of which also failed, as did other similar experiments. Almost discouraged, but still stimulated with a desperate hope of ultimate success, he ground up another quantity of corn and treated it with a solution of lime. Again success evaded him. But he was now nearing his triumph. He had thrown the first lot, treated with a lye solution, into a receptacle, and to this, in his discouragement, he added the last quantity, upon which he had experimented with lime, and left them to be thrown away with the results of many former failures. On entering the room a few days later to put it in order, he proceeded to empty the tub, and to his great joy and surprise found at the bottom a quantity of beautiful white starch, thoroughly separated. Continuing his work, he rapidly perfected his process, and in 1842 produced his first quantity of marketable starch. Mr. Kingsford fully realized the importance of his discovery, although his most sanguine anticipations could scarcely have led him to hope for the great success that followed. Corn was then vastly cheaper in comparison with wheat than it is at the present day, thus promising lower prices and greater profits, as well as increased demand for the new starch. He freely exhibited his product to buyers and consumers, as well as to his employers, and there was only one verdict: it was incomparably superior to any other starch. Now he did not have to ask for financial aid. William Colgate & Company were ready and anxious to make any investment necessary to establish the manufacture if they could share in the profits, and a business engagement was accordingly effected, under which Mr. Kingsford was to superintend all the operations and devise the necessary machinery for the manufacture, at the same time retaining the knowledge of his process for himself. None of the starch-making devices formerly used in the factory could be utilized, and he set himself to the work of inventing and building special machinery for the new process. The task was successfully accomplished, the manufacture began, and the new starch soon reached consumers in comparatively large quantities. It met with prompt and universal favor, and soon crowded the former starches from the market.

In 1846 the firm of T. Kingsford & Son was formed by the association of Thomas Kingsford and his son Thomson. They erected a small factory at Bergen, N. J., and there the manufacture of the Kingsford starch was successfully inaugurated. As the knowledge of the superiority of this starch spread, and the rapidly increasing demand became known, capitalists came forward with propositions for investment in the business. This resulted, in 1848, in the incorporation of an organization styled the Oswego Starch Factory, and the removal of the business to Oswego, N. Y., where suitable factory buildings were erected. Unfailing water-power, a pure water-supply for manufacturing purposes, and good shipping facilities were the chief advantages secured by this change of location. In 1850 Thomas Kingsford became impressed with the conviction that, by following processes somewhat different from those employed in making laundry starch, a food-substance might be produced from corn, which would be free from the objections inherent in corn-

meal, extremely nutritious, and at the same time suited to the most delicate or infantile stomach, supplanting arrowroot, sago, tapioca, and similar farinaceous foods. He immediately began a series of experiments, which resulted in the discovery and production of the now universally known corn-starch for food purposes. From 1842 the demand for corn-starch continued to increase, leading to the establishment of many plants; but the concentration of the starch interests into fewer hands has within the past few years resulted in the cessation of work in seventeen factories. There are at present sixteen factories engaged in the manufacture of starch from Indian corn in this country, with an aggregate capacity of 29,000 bushels of corn per day, producing 206,673,000 pounds of starch annually, valued at $8,738,895. In this branch of the industry there is, at present, an invested capital of $8,450,000; 11,740 horse-power are required, and 2219 hands are employed. In 1891 a combination or trust was formed, composed of many of the starch companies in the United States, and called the National Starch Manufacturing Company. The manufacture of starch may be counted among the leading industries of this progressive nation, and a large proportion of the product is annually shipped to, and finds a ready market in, foreign countries.

Like other industries, the growth of starch manufacture has kept pace with our ever-increasing population. In 1880 there were 139 factories engaged in the manufacture of starch from potatoes, wheat, and corn. Ten years later there were but 80 factories, which would seem a falling off of the industry. But a carefully prepared table of facts concerning the subject shows a marked increase in the number of hands employed, quantity produced, and value of annual product. A brief summary shows a total of 2966 hands employed in potato, wheat, and corn starch factories, utilizing 13,526 horse-power, producing 238,993,352 pounds of starch annually, valued at $9,939,592.33, and employing $9,000,765 capital.

Thomson Kingsford

CHAPTER LXIX

THE MATCH INDUSTRY

BY the coaction of thought and energy are all things developed from nature. The quick-whirling, sharp-pointed stick of hard wood, brought in contact with resisting hard wood, generated by friction the heat which gave primitive man his first spark of fire. That primitive man who, with energized thought, produced the first spark of fire was a greater inventor than any who followed him up to the day when man harnessed electricity to produce the same spark of fire. How similar their methods,—action and reaction; the positive and negative poles of the battery; the whirling armature of metal coming in contact with metal, generating the heat-fluid that is distributable by proper conductors; yet how great the step in mechanics between the two—one base and rudimentary, the other the perfection of mechanics!

It has been written that "human culture may be said to have begun with fire, of which the use increased in the same ratio as culture itself." The ancients regarded fire as a sacred element, and, when once produced, it was watched, replenished, and cared for with a religious zeal by virgins, who were scourged if they permitted it to expire.

To the development of mechanics and chemistry we owe our progress physically; and while some branches of industry may attract more attention than others on account of their importance, it would seem that all have traveled along at about the same pace and made about the same progress, the match industry, like its neighbors, only keeping step to the music of the rapid march of industrial affairs. The progress made in the methods of producing fire quickly was for several centuries exceedingly slow, taking into consideration the fact that phosphorus was discovered in the eighth century by an Arab named Bechel. Owing, perhaps, to lack of proper chemical and mechanical appliances at that time, it dropped from sight, and was rediscovered in 1669 by Brandt. Both Bechel and Brandt discovered it in liquid human refuse after it had been changed by keeping. Later it was procured from human bones, and still later from all kinds of bones; and now it is extracted by electricity from mineral phosphates. It is exceedingly strange that, while its properties were well known for several centuries, its application to matches dates back only a little over half a century. It would be hard work to compute accurately the value to the human race of the introduction to general use of this useful little article.

It is estimated that five matches per day are used for each man, woman, and child in the United States, and that fifteen seconds are required to consume a match, while the time required to produce the same number of fires by the best-known methods before matches were invented would have been ninety hours per annum for each person. The difference between the two methods would figure out a saving, at five cents per hour, of over $270,000,000 per annum to the people of the United States.

The original discovery of the ignition of phosphorus and sulphur by friction was made by Godfrey Haukwitz in 1680. About one hundred and fifty years later, Walker, of Stockton-on-Tees, invented the friction-light. Two or three years prior to that the famous instantaneous-light boxes were in use. These were called Eupyrions and Prometheans, and consisted of sticks of wood tipped with sulphur and chlorate of potash, which ignited on being dipped into sulphuric acid. These instantaneous lights retailed at a very high price. The lucifer or improved friction-match succeeded them in 1833. The first patent granted in the United States for a friction-match was to Alonzo D. Phillips, of Springfield, Mass., October 24, 1836, and the manufacture in this country began in the same year.

The splints were whittled out by hand at first, and continued to be made in a crude way until 1842, when Reuben Partridge patented the first

splint-cutting machine. The discovery of red or amorphous phosphorus was made by Schrotter, a German, in the early fifties; and one of its earliest users was Herr Lundstrom, of Jönköping, the original Swedish safety-match manufacturer, in 1855–56. A history of this industry in 1856 states that it had reached gigantic proportions in Sweden, Germany, and England. In the latter country there was an average daily output of 40,000,000 matches in that year. To-day the Diamond Match Company's largest factory, at Barberton, O., has facilities for turning out 100,000,000 matches per diem.

How quickly, in the familiarity of common use, has the little match lost its merited consideration as an important factor in human events, and how little do we realize its importance in commercial affairs! There are consumed in the United States 115,200,000,000 matches per annum, which, if put end to end, would reach a distance of over 4,000,000 miles, or span the earth 170 times. Allowing eleven matches to the inch in width when put side by side, they would make a band around the earth fifteen inches wide.

There are annually consumed in the production of matches in the United States, and in casing them, over 40,000,000 square feet of pine lumber one inch thick; 8000 tons of strawboard and paper are used in boxing and wrapping them for market; 3,500,000 pounds of paraffine and brimstone are used for saturating the ends of match-sticks; and 6,000,000 pounds of chemical compound are used for match-heads. About $7,000,000 are invested directly in the match business, and $5,000,000 are invested in lumbering and manufacturing enterprises, owned and operated by the match manufacturers to supply themselves with materials used in the making of matches. The annual product is delivered to the consumer for about $7,000,000. In the match business proper about 2200 people are employed, and as many more are employed in the manufacture of material for matches. The aggregate wages paid amount to about $1,500,000 per annum.

The production of matches has been attended with a great amount of misery which is incidental to the business. People of scrofulous or delicate constitution who are brought in contact with phosphorus in handling matches, or who daily inhale the fumes of phosphorus, are frequently attacked by a most distressing disease called necrosis of the bone. It usually attacks the lower jaw-bone; when it attacks the upper jaw-bone death is almost certain. In the early history of match making the business was conducted in the crudest way possible to imagine. It was driven by competition into the hands of the poorer classes of people in London and in the larger cities of the continent of Europe. The manufacture was in cellars; and so numerous became the cases of this most loathsome disease that the different governments drove the manufacturers out of the cellars and ordered that they work in better-ventilated buildings. Despite the growth of the business the evolution of machinery in the manufacture has very much lessened the number of people employed, and reduced the danger of this disease to the minimum.

From whittling out match-splints in 1833, when matches were first invented, there has followed a mechanical development (the several steps of which would be more interesting to the specialist than to the general reader, and will not be dwelt upon in this paper), until now the most perfect and modern machinery is used in their manufacture. The operation of these machines may be described as follows: The wood from which the match-splints are made is pine plank, two inches thick, which, after being thoroughly dried, is resawed into lengths from one and seven eighths to two and one half inches, representing the length of the matches to be made. The knots and cross-grained parts are cut out of the blocks, and only good straight-grained lumber is used. These blocks are then put into the automatic feeder of the machine, the paraffine and composition for the head of the match having been properly prepared and placed in their respective receptacles, which are so arranged that they can be replenished from time to time without stopping the machine. The knives or dies that cut the match-splint from the block are so placed in the head-block of the machine that when the splints are cut they are separated by a quarter of an inch, and placed or set in cast-iron plates made into an endless chain by link attachments. At each revolution of the machine forty-four matches are cut and set, the machine making from 175 to 250 revolutions per minute, its rapidity depending on the length of the match and other conditions.

From the cutting end of the machine the endless chain moves along over a drying or heating block prepared for this purpose, where the match-splint is heated to a degree nearly equal to that required to melt paraffine, so that the paraffine may not chill on the stick when the splint passes through it, but that the end may be thoroughly saturated. The chain continues to move on in its course to the composition rollers, where the match receives its head; thence on in a circuitous route, passing back and

forth, coming in contact with blasts of cool, dry air for a period of one hour and a half, when it returns to the place of beginning, just before reaching which the matches are punched out of the chain by an automatic device into small paper or strawboard boxes varying in size, capable of containing from 65 to 500 matches, the boxes having been fed into the machine by an automatic device with such regularity that one might almost truthfully say that the matches were counted into the boxes; the chain continuing along to take other match-splints on their round, to be made complete matches and dropped in turn into other boxes. These boxes of matches pass from the machine to a rotary table, around which sit from two to four girls, who take the boxes, place the covers on them, and then pack them into cases.

The machines require just enough manual help to feed them the raw material and to take care of the manufactured product, and are so nearly perfect that it does not seem possible for much further development to be accomplished. The world is indebted for the present perfection, first, to the policy of the Diamond Match Company, which has kept employed, since its organization in 1881, a corps of expert inventors and mechanics for the invention and improvement of its machinery, at an expense of at least $50,000 a year; second, to the inventors themselves, chief among whom are E. B. Beecher of Westville, Conn.; McClintock Young of Frederick, Md.; J. P. Wright of New Haven, Conn.; Joseph Baughman of Akron, O.; Charles Palmer of Akron, O.; and John W. Denmead of Akron, O. The writer has occasionally added a thought in this development, especially as to the architecture of factories best adapted to match manufacture, and so arranged as to bring the danger from the use of phosphorus down to a minimum.

Coincident with this development of machinery for the manufacture of matches has been that of machinery for the manufacture of paper and strawboard boxes used in the match business, a large part of which machinery has been the creation of E. B. Beecher. Its operation is as follows: A roll of strawboard of proper width, lined with white or colored paper, is placed in the machine, which takes it and scores the board for the corners without cutting or breaking its fiber. The strawboard is then glued by an automatic device and folded into an endless tube, passing on in that form through printing-presses that print three sides of the tube. It is then cut into proper lengths. Passing on in the machine, it is sanded on the fourth side, which makes the rubbing surface for the ignition of the match. This forms the cover or outside of the boxes; these covers are turned out from the machine at the rate of 450 per minute. The boxes proper are made in a similar way, by machinery which folds and glues them in shape.

The immense saving to the world by the introduction of machinery for making match-boxes is indicated by the following facts: There are now used in the manufacture of matches in the United States at least 2,000,000 paper or strawboard boxes per day, which, if made by hand, as the greater part of them were twenty years ago, would require at least 1500 people; while now it requires to operate the machines that make these boxes not over 75 people. Besides this great saving of labor, a great saving in the use of strawboard and paper for labels, paste, etc., has followed the introduction of machinery, machine-made boxes being much lighter and stronger. A further economy has been achieved in the space required for the manufacture of boxes. Strange to say, in England and parts of the Continent handmade boxes are largely used, the material for them being weighed out and charged to people who call for the work and take it home to complete, returning the finished boxes to the factory in due time. This work is taken at prices which indicate, at least, that it is not done in brownstone houses. It is one of the strange sights to be seen in London and Liverpool, this giving out of material for match-boxes to the poorer classes of people. It is at once picturesque and disgusting. "May human life never be so cheap in America," is one's first thought on witnessing it.

Nature has queer ways of working out her problems. Perhaps it is this very cheapness of human life abroad that has prompted the better fed and housed Yankees to inventive habits. Certain it is that they have made greater progress in match making than any other people on earth. To-day the largest match-making firm of England or the Continent is using match machinery invented by Americans over thirty years ago, while Americans are using machinery that is making a saving in labor over that referred to of seventy-five per cent. The Diamond Match Company is now constructing in Liverpool, England, the largest match factory in the world, for the introduction of the latest and best-known methods for the manufacture of matches. It would not be strange if, with the cheap labor and the saving in cost of material, chemicals, etc., some of the products of these works should reach the eastern shore of this continent. Such has been the evolution of the match industry, with and without protection.

The effect of this automatic machinery of the match industry is easily summed up. In 1880, before the organization of the Diamond Match Company, there were in existence throughout the United States over thirty match factories, employing about 4000 people. The total product of all these factories at that time was 2,200,000 gross per annum, which constituted at least ninety-five per cent. of all the matches that were consumed in the United States, there being but very few imported; while now, with a much smaller number of people employed, four times as many matches are produced, the greater part of which are consumed in this country. Manufacturers' prices of matches have been reduced from fifty to seventy-five per cent. The consumption of matches has been increased much more than in proportion to the increased population of the United States, this result being largely due to the low prices at which they are sold.

A very large portion of the material used in the composition for the heads of the matches in this country is imported. Chlorate of potash, of which there are consumed in matches in this country 1,500,000 pounds per annum (besides several millions of pounds that are used for other purposes), is all imported—not one pound of the article is made in the United States; and the same is true of some other chemicals used, notwithstanding that they could be prepared here as cheaply as in Europe, barring the difference in the price of labor. With a judicious system of protection to those American industries which need it there is no reason why, in a few decades, we can not only be self-sustaining and independent as a manufacturing and commercial people, but be able to compete for the trade of the world on an equal footing; though we cannot expect to command for a long time yet much of the trade of other countries. The civilized nations of the world are each encouraging home industries by protective tariffs on such articles as require their fostering care, and are especially appealing to the patriotism of their people to patronize home industries. The sooner that the American people learn that foreign countries buy of us only such articles as they are forced to buy, so to speak, the sooner they will be prepared to save to themselves the greatest market on earth—that of their own country. Although we may pride ourselves on the great progress that has been made in the physical and commercial development of our country, there seems to be plenty of work yet to do.

The writer visited match factories last year in Belgium, Germany, Italy, France, and England, and he was unable to discover any material progress made by these different people beyond the processes in vogue in America twenty-five years ago. Of course, the people of those countries have not had the stimulus of high wages to prompt them to the use of labor-saving machinery. In Italy the writer visited a match factory where several hundred people were employed at wages that in our country, with our habits of living, would not furnish even the common necessaries of life. A large number of girls worked for wages not exceeding nine cents per day, and the most that was paid to girls in this factory was one franc per day. The writer's attention was naturally attracted to these people. One of the girls had on a knit blouse, so open and loosely knit as to disclose the fact that the wearer had a chemise underneath; a calico skirt, hooked together at the waist over the blouse; and a cotton underskirt that showed itself in spots. Her legs were bare, as revealed by the shortness of the skirt, which did not reach half-way below her knees; and on her feet were wooden sandals. The effect of the whole was plainly to outline her rounded contour. Such a costume would not be recommended to New York's four hundred, but it was none the less suggestive of comfort, as the weather was warm. It is probable that the whole outfit did not cost one dollar. Like their sisters of high society, some of these girls were better dressed than others.

If to do the greatest good to the greatest number be an economic principle, then the American people should be thoroughly satisfied with their match supply, matches being so cheap that they are often used for kindling-wood without materially affecting the expenses of the household. Such results could only be obtained by the best methods of manufacture and distribution. Before the business of manufacturing matches in the United States was so thoroughly organized by the Diamond Match Company matches were made by over thirty different companies, many of which did not know the first principles of the manufacture of good matches. Notwithstanding competition was then very sharp, the bulk of the product was sold at about three times the present price of matches, and in many cases the goods were utterly worthless.

The expense of conducting the business in those days was enormous, comparatively, and, of course, increased the price of the goods. In the city of Chicago five separate stores were maintained, with all the expenses incident to such establishments; and in other cities of the country there were stores

in proportionate number to the amount of goods sold. Moreover, each manufacturer had from one to five traveling salesmen tramping over the country at large expense, not less than from $2000 to $3000 per annum each. The system has been so revolutionized that one store in each of the larger commercial centers supplies the public need for matches, with greater facility than in the olden times, and very few traveling men are now found necessary in this line of business. The public have received the benefit of these economies.

To still further lessen the expense of the production of matches, the management of the Diamond Match Company has adopted a policy, so far as it has been practicable to do so, to make the company as self-supplying and independent as possible, they having invested several millions of dollars in manufacturing many of the articles used in the making of matches, and in pine forests, and large mills for the reduction of pine-trees to lumber for splints by the most economical methods, in order that all possible waste may be avoided. These investments could be profitably made only by a company using such large quantities of these several articles as are used by the Diamond Match Company. A comprehensive system of factories to supply the want of matches has been advantageously distributed through the country. Nearly all of these factories have been modernized and brought up to a very high standard of efficiency. While concentration of capital in this business has brought down the number of factories to about twenty, the match business is in no sense a monopoly, and many times more people are now interested directly in the business than were before the Diamond Match Company was established in 1881. The company is rather in the nature of a coöperative company (although regularly chartered), in which every important person in the business from time to time, as he comes on the stage, is aided to the ownership of stock in the company. The liberality of the management in this particular has wedded to the business a corps of very able young men in each and every branch of their different factories and stores.

The difference between this company and a monopoly is illustrated by a comparison of it with a monopoly in the same line of business. The French government runs the match business as a government institution. The revenue or profit derived from it is somewhat over $4,000,000 per annum. The cost of matches to the French people is quite four times what is paid for better goods in America. The "Pall Mall Gazette" of recent date describes this monopoly in the following language:

"Those who have had occasion to travel much beyond Calais of late cannot fail to have been struck by the fact that, since the French match makers struck, matches in France have, in an unusually large number of instances, been found capable of doing so. The 'Matin' supplies an explanation of this phenomenon. The matches that have been striking were all made in Belgium. During the strike the French government has been drawing its supplies from Ghent. It appears Ghent can supply this sort of matches at £3 4*s.* 2*d.* per 1,000,000, whereas the match-wood turned out by the French factories costs not less than £5 8*s.* 4*d.* for about the same number of misfires. So the 'Matin' has been moved to make a little calculation. And, according to this, it would seem, if France were to give up the business altogether, close her factories, pay the hands to do nothing for the term of their natural lives, and run the Belgian articles, she would net an annual profit of £8000. This sounds very nice, and Mr. Ribot could do with the money, and there would not be nearly as many bad words about. But then, as another Paris journal points out, the thing would be unpatriotic, and when patriotism wants a light it will probably have to go on using those words, or learn the two-stick trick to get one."

One is a monopoly, run by the operatives, not by the owners; the other is a company largely owned by operatives, who carry on the business for their own benefit, the result being economies whereby the public is greatly benefited.

One of the greatest achievements of the Diamond Match Company was its last winter's lumbering operation, conducted by J. H. Comstock, who organized a force of men in October, and between the 1st of October and the 1st of April cut 185,000,000 feet of lumber in logs, having at one time in the woods over 6000 people and 1200 horses. The expense was over $600,000. This work was made necessary by the extensive fires of last fall in order to save the lumber. Such is the advantage of capital in preventing waste.

The writer, who has had forty years' experience in the match business, has not only seen it wonderfully developed, but he has been equally impressed with other lines of development that have had an effect on it. The method of distribution of matches in the early fifties was by canal or wagon—at least in the West, when there were but very few railroads in Ohio and west of Ohio, and the roads then run-

Ohio C. Barber.

ning would not transport matches, which were considered too dangerous.

It was only in the early sixties that railroads began to carry matches. The writer has been in every county in Ohio with a wagon, also in a large portion of Michigan, Indiana, West Virginia, and western Pennsylvania, on the mission of parceling out to the country stores small lots of matches, for which he did not always get cash. In fact, all cash was the exception, and the business was chiefly done in what then was called "barter"; that is, matches were traded for calico, cotton cloth, boots and shoes, tea and coffee, sugar, candles, and everything else that was useful in the home and could in turn be traded off to the hands in payment of labor. The cash received in those days for matches went to buy lumber, brimstone, phosphorus, and other chemicals used in their manufacture, which were all imported, with the exception of lumber. It was very little cash that labor received in the West "in those good old days." There was one notable exception when cash was paid out to hands, and that was when a circus was in town, the amount required being twenty-five cents per head. And all went, if it took the last cent.

The evolution from these methods to those of to-day is quite as remarkable as the evolution in mechanical development. Strange it is that a condition of trade could exist such as existed in this country in the fifties, when there were produced from the mines of the country so many, many millions of dollars of gold, all going out to foreign countries in the purchase of merchandise which we were unable to manufacture.

Prominent among the men who have developed the manufacture and distribution of 115,200,000,000 matches per annum (so that no person shall want for matches in the United States if willing to pay a very moderate price for them) are found William Gates (deceased), Frankfort, N. Y.; George Barber (deceased), Akron, O.; D. M. Richardson (deceased), Detroit, Mich.; John K. Robinson, Chicago, Ill.; E. B. Beecher, Westville, Conn.; L. W. Beecher, Westville, Conn.; James Hopkins, St. Louis, Mo.; William H. Swift, Wilmington, Del.; Joseph Swift, Wilmington, Del.; M. Daily, Philadelphia, Pa.; William M. Graves, Chicago, Ill.; George P. Johnson, New York City; E. G. Byam, Boston, Mass.; J. C. Jordan, Portland, Me.; James Eaton (deceased), Utica, N. Y.; Henry Stanton (deceased), Syracuse, N. Y.; James Clark (deceased), Oshkosh, Wis.; William H. and J. H. Moore, Chicago, Ill. These last two gentlemen became largely interested in the business in 1889, and have aided greatly in bringing it up to its present commercial importance.

O. C. Barber

CHAPTER LXX

THE ICE INDUSTRY

THE use of ice as an article of commercial importance dates from early in the present century. It is to the people of America above all others that the credit must be given for its rapid development as an industry, hardly less phenomenal than the progress of steam, the improvement of the printing-press, and the introduction of electric and other inventive industries.

Prior to the beginning of the present century we learn little as to the use of ice. Dating back to the days of Job, we find him singularly oblivious to his opportunities when the Lord called his attention to "the treasures of the snow," "the treasures of the hail," "the ice," and "the hoar-frost of heaven." Galileo seems to have been equally inappreciative, notwithstanding that he is accredited with having been the first to observe that "ice is lighter than water; hence it floats." In the early ages of Greece and Rome it is shown to have been used, snow in the days of Seneca having been sold in the shops and peddled upon the streets of Rome. The snow thus used was collected on the dry plains of Hannibal's camp on the ancient Mons Albanus, where pits were dug, cone-shaped, about fifty feet deep and twenty-five feet in diameter at the surface, then filled with snow, and beaten down as hard as possible, the pit having been first lined with straw and prunings of trees. The extreme bottom of the pit was obstructed by a wooden grating, in order to form a drain; and more prunings being added, a thatched roof was put on, and a door, well covered with straw, left at the side, through which entrance could be effected for the purpose of cutting out with mattocks the ice thus formed. In the East Indies a somewhat analogous example appears, the pits there, however, being about thirty feet square by two feet deep, lined with sugar-cane or the stems of dried Indian corn about a foot thick. In these pits shallow earthen dishes are placed, which are filled at dusk with water that has been boiled, which readily freezes during the night; and at sunrise hundreds of laborers carry the thin sheets of ice thus formed to deep pits, ramming them down to force them to congeal into a solid mass. In China a like method is pursued.

In the reign of Henry III. of France, toward the close of the sixteenth century, the use of snow for cooling liquors at the tables of the wealthy became somewhat general, and its sale near the end of the seventeenth century was made a profitable trade in some parts of that country. From that time to the early part of the nineteenth century little progress was made in developing the use of ice, although some experiments were made in increasing refrigeration by mixing saltpeter and snow with ice, and in congealing by cold various juices, creams, and other luxuries. I refer to the original manuscript of an article prepared for the United States census of 1880 for thus much of "ancient history," as, strange to relate, the literature of the business may be said to be still in its infancy; and the absence of accurately compiled statistical information from the various sections of our own country, as well as others, prevents such a résumé as can be given from properly conveying a clear idea of the magnitude of this wonderful outgrowth of American enterprise.

When Daniel Webster moved to Marshfield in 1835 and cut his own ice, he had seen but the birth of this new child of nineteenth-century progress, and but little of its infancy, for it had not then developed into youth. The year 1805 may be taken as marking the first stage of its life, if we except the shipment made from New York in the year 1799 by a gentleman in Charleston, S. C., who chartered a vessel for a cargo which was cut on a pond near Canal Street, in the city of New York. In 1805 Martinique's hot sun destroyed the frigid cargo of 130 tons which had gone to its shores from Yankeedom in the little brig *Favorite* to assuage the sufferings on that fever-swept island. The ill results of that experiment, by which $4500 were lost, only temporarily

disheartened its originator, Frederic Tudor, son of Judge William Tudor, who as a colonel had served on the staff of General Washington. The brig *Trident*, two years later, carried Mr. Tudor's second shipment from Boston, which arrived in Havana, but likewise proved unprofitable. The War of 1812 caused a cessation of his efforts, and not until the year 1816, after obtaining a concession from the Spanish government securing a monopoly in Havana, did he again venture to export from Charlestown, Mass., cargoes of ice to the South. Their successful sale justified further ventures to other Southern ports on our coast, and the Stars and Stripes for succeeding years waved over many an American ship freighted with frozen crystals which found a welcome in home and foreign ports as far as the East Indies. In 1817 and 1818 the trade was extended to Charleston and Savannah; in 1820 to New Orleans; in 1833 to Calcutta; in 1834 to Rio Janeiro. An illustration of the progress of ice exportation is furnished in the following table:

EXPORTATION OF ICE.

Year.	Number Cargoes.	Quantity. Tons.
1806	1	130
1816	5	1,200
1826	15	4,000
1836	45	12,000
1846	175	65,000
1856	363	146,000

In this latter year shipments had covered ports in the West Indies, South America, Ceylon, Calcutta, Bombay, Madras, Batavia, Manilla, Singapore, Canton, Mauritius, and Australia. In 1842, Gage, Hittinger & Company, of Boston, entered the field as exporters, and introduced American ice by the bark *Sharon* to the people of London. Mr. Lander, of Salem, followed them in this trade. In 1872 shipments had increased to 225,000 tons, and thus the trade continued until the year 1880, when the extraordinary failure of the ice crop opened the field in tropical countries for manufacturing ice. In that year the shipments by 1735 vessels from the Kennebec alone amounted to 890,364 tons.

Thus the irrepressible American was different from Job and Galileo; he saw his opportunities and made the most of them. In a few years the business was begun in Eastern cities, notably in New York, where it has since attained the most gigantic proportions. Previous to the introduction of Croton water into that city, the earliest efforts at gathering ice, excepting the first shipment in 1799 to South Carolina before referred to, were directed by a few butchers desirous of preserving meats for the wants of the small population. Their ice came from what was known as Sunfish Pond, on the outskirts of the city. In the year 1826 some ice was cut on Rockland Lake, the purity of this water particularly commending it. This ice was conveyed from Rockland Lake landing in a rude box, set upon a truck with wheels cut from logs of wood, to the sloop *Contractor*, commanded by Captain John White, and from the sloop it was trundled around ashore in a one-horse cart until sold. Later the steamboat that made a trip from Haverstraw and return in two days brought all the supply to the city customers. As in Boston, these pioneers thought ice could not be kept aboveground, and therefore stored it in a large hole twenty feet square by fifteen feet deep. Then followed the building of stone houses at the old red fort, Hubert Street, in New York City, and another at the foot of Christopher Street. This plan of storage was eventually abandoned, owing to the waste ensuing from frequent exposure of the ice while loading wagons. Thereafter followed, as the business grew, the erection of storehouses at the lakes and other places where ice was first gathered; these storehouses varying greatly in size, but ordinarily built about 100 or 150 feet in length by 36 to 40 and 50 feet in width, and containing rooms more or less in number for the separation of the ice. These rooms in some of the States are each called a house, although all are under one roof; while elsewhere an aggregation of rooms is designated a house. Thus an owner of a twelve-room house is spoken of in one section of the country as owning twelve ice-houses, and in another section as owning one house. The storage capacity of houses ranges from 10,000 to 90,000 tons, 30,000 tons being a fair average accommodation; and the total storage of natural ice for mercantile use may be safely estimated for the whole United States at 10,000,000 tons.

A lack of unity of interest and harmony in the trade, and a tendency to overestimate rather than underestimate the magnitude of individual operations, have resulted in promoting incorrect opinions as to the storage capacity, the consumption, and the capital invested. Thus, in some cases, chartered companies have been erected upon fictitious value, arbitrarily fixed without reference to intrinsic or market value, often comprising sums stated as consideration for "good-will," a rather valueless commodity in many cases. Shorn of these values, however, an estimate taken from the best information at hand, and from actual inspection of most of the

large centers where the business is conducted, results in fixing the entire capital engaged in the ice business of the United States, inclusive of that invested in manufacturing ice, at not less than $30,000,000; and the production for commercial use at about 15,000,000 tons, about one half of the crop gathered being available for use, the waste by melting and chipping amounting to fifty per cent. No provision, however, is made in this estimate for the business conducted in the small towns and villages of the country, of which it is impossible to obtain statistics.

To move this great body of ice requires a large fleet of vessels—sailing vessels for export, and mostly ice-barges and other boats for the home trade. The railroads also, in many sections, are largely used for transportation, more particularly in the West, where the value of the ice dealers' patronage has been recognized in rates that make it possible for dealers to use cars in transportation profitably; whereas in the East this has generally been found to be impracticable, except where the railroad company has entered into competition with ice dealers to build up its own freight by controlling ownership of the ice plant. In the year 1878 large quantities were shipped in train-load lots by the Knickerbocker Ice Company, of New York, to Cincinnati and other cities in the West and South, twelve gross tons weighing out ten net tons, much to the surprise and admiration of buyers in those cities for the skilful packing. Ice was railroaded afterward in the same year to St. Louis from Maine —a longer distance; but the experiment was not repeated, owing to a waste of fifty per cent. The large fleets of ice-barges traversing the Hudson by day and night, in tow of steam-tugs, during the season of navigation, which is limited to an average calculated during fifteen years at 268 days, form a picturesque scene familiar to tourists on that river; and the great storage-houses so numerous on its banks between Rondout and Coxsackie have awakened their wonder, equipped as they are with elevators and chains, stored away during the summer, but which in winter run to the music of steam-power with the white blocks of crystal from the water to the interior of the houses. The electric power has not yet been put in service there, except for light while working at night. The movement of the large stock of ice required for New York and adjacent cities must of necessity be made in the limited period for water transit, the record of fifteen years showing a closing of navigation on the Hudson an average of ninety-seven days in the year. Over 1500 wagons and 3000 horses are in use for the distribution of ice in the cities of New York and Brooklyn alone, and the weekly pay-rolls in these two cities for laborers engaged in such work amount in the summer with the leading dealers to about $25,000 per week. To the yearly pay-rolls must be added the cost of towing, loading, and discharging barges, dock and stable rents, repairs and maintenance of boats, wagons, ice-houses, and other things in which the deterioration from usage is rapid, and it will be found questionable whether any other industry returns out of its receipts so large a percentage to the people from whom the revenue is derived.

The manufacture of ice-tools and machinery, as a necessary adjunct of the ice business, is made a specialty by some dealers in this country, who thus have attained not only a national but an international reputation for excellence of work. Mr. Nathaniel Wyeth, of Boston, who constructed the first double-walled modern ice-house, has the credit, in connection with Mr. John Barker, of the same city, of inventing many of the ice-tools, now numbering over seventy, which supplemented the primitive ax and hand-saw used in the early years of the business. The Norwegians were the first foreigners to recognize the advantage of American ice-tools and machinery, after the invention of ice-plows in the year 1839 (although the patent clearing-tooth was not invented until the year 1872); and it was not many years after the exportation of ice was shown by Americans to be practicable that certain of those Northmen visited this country to learn the method of harvesting, storing, and shipping, which business dealers in that country have since largely pursued. Some cargoes of Norwegian ice have found a ready market in the city of New York in seasons of scarcity, the first cargo arriving in the year 1880.

The production of cold by artificial means has attracted attention from a much earlier date than is generally supposed. The existence of porous clay vessels for cooling water in Egypt, Arabia, China, and other Eastern countries would indicate that this method antedated the use for like purposes of even ice itself, notwithstanding ice was already prepared in nature's own laboratory. In the southern part of the eastern hemisphere, where ice could not be found, the earliest process was the plunging of wine-bottles in water to lower the temperature of the wine; then succeeded the plan of wrapping them in wet cloths, thus applying the principle of evaporation, a principle still in existence combined with the use and solution of saline substances. When snow

Robert Maclay.

could be procured it was substituted for water, and eventually the application of salt was found to hasten evaporation. The use of ether was also known as productive of cold by evaporation shortly after its discovery; and in India it was common, owing to the cheapness of niter, to use a solution of niter and water also as a cooling mixture for wine. The becarros of Malaga and the alcarrazas of Spain are but modernized developments of those cooling vessels which the Saracens introduced, and faithfully attest the antiquity of the practice of artificial means of refrigeration. The record of early experiments for mercantile uses starts with the Italians in the sixteenth century. Lord Bacon later took some interest in the matter; and the record of the results of the experiments of Mr. Walker, of Oxford, England, in 1795, contains highly interesting tables of many freezing mixtures. Professor Leslie, of England, produced a considerable degree of refrigeration on the principle of including in the exhausted receiver of an air-pump sulphuric acid, a substance rapidly absorbing vapor. Later experiments were made by French and German inventors. The ether-machine followed, being patented in Connecticut in 1850; but a serious danger arises from the use of ether, owing to its liability to explosion in case of leakage. Other machines have been made using liquefied ammonia, and others sulphurous acid and various frigorific mixtures. More progress in these has been made by manufacturers in this country than elsewhere, particularly in the commercial use of cold air for refrigeration in breweries and places where cold air only is required, but with more varying success in the production of ice itself for consumption, except at points remote from the sources of natural ice-supply. Thus in the South, and notably at points away from the coast, machine-made ice has been handled to better advantage than the other; but the cost of manufacturing such ice, even without the additional cost of making a chemically pure article, precludes the prospect of ever bringing it profitably into competition with ice formed by nature's own hand.

America may well be proud of the ice industry, and may well claim its parentage. It brings comfort to the afflicted, it puts sweetness and purity in the place of decay, and by wasting gives up its own life to save lives greater and more valuable. It promotes the honest investment of capital, and feeds and clothes laborers by the thousands. On the fields adjacent to the city of New York alone it finds employment in the harvesting season for from 15,000 to 20,000 men, and in its distribution during summer for nearly 5000 men. The cost of harvesting goes to the laborer, thence to the merchant; the costly plants set as jewels among the farm lands, wherever located, reduce the taxes of other landowners; and thus all classes reap a benefit from the money which stores, moves, and distributes the crop. It is a productive industry in the fullest sense, and as "blessed is he who makes two blades of grass grow where one grew before," so should this industry, in all the glory of its productive power and beneficial results, be fostered and classed among the thousand things which stir the pride of the American people in this nineteenth century.

Robert Maclay

CHAPTER LXXI

SODA-FOUNTAINS

JAMES PARTON, in his "Life of Thomas Jefferson," says of Dr. Joseph Priestley: "It is not true that no public memorial of Dr. Priestley has been erected. Every soda-fountain is his monument; and we all know how numerous and splendid they are. Every fountain, too, whence flows the home-made water of Vichy and Kissingen is a monument to Priestley; for it was he who discovered the essential portions of the process by which all such waters are made. The misfortune is, however, that of the millions of human beings who quaff the cool and sparkling soda, not one in a thousand would know what name to pronounce if he were called upon to drink to the memory of the inventor. And really his invention of soda-water is a reason why Americans should join in the scheme to honor his memory. He not only did all he could to assist the birth of the nation, but he invented the national beverage."

"Soda-water," or, more correctly, carbonated water, which is simply a mechanical mixture of carbonic-acid gas with water, was first made by Professor Venel, of Montpellier, France, whose researches were laid before the French Academy of Sciences in 1750, by mixing two drams of soda and "marine" acid in a pint of water contained in an ordinary glass bottle. Carbonic acid was discovered by the Belgian chemist, Van Helmont, in the early part of the seventeenth century. He coined the word "gas" to designate it. Lavoisier named it carbonic acid, and Priestley, in 1767, produced a carbonated beverage by pouring water briskly back and forth between two small vessels held in a layer of carbon dioxide on the top of the fermenting mass in a brewery vat at Leeds, England. Bergman, the Swedish chemist, in 1770 generated carbonic-acid gas from chalk by the use of "vitriolic acid," and invented a generating apparatus for the purpose. In 1810, Simmons and Rundell, of Charleston, S. C., were granted a patent for saturating water with "fixed air." John Matthews, of New York, in 1832 began the manufacture of soda-water, and apparatus with which to make it, and may fairly be termed the father of soda-water as it is known in the United States. Matthews, who learned his business in England under Bramah, manufactured generators of cast-iron lined with lead, in which he produced carbonic acid from marble-dust and oil of vitriol, purifying it by passing it through water in a purifying chamber, whence it was conducted into fountains of cast-iron lined with block-tin, in which the gas was combined with water by means of a revolving agitator, or by rocking the fountain, which, for this purpose, was mounted by means of trunnions in a cast-iron frame. His dispensing apparatus was a simple draft-tube projecting from a counter, beneath which the fountain was incased in ice, or the fountain and draft-tube were connected by means of a coil of pipe placed in an ice-box; the syrups for sweetening and flavoring being kept in glass bottles on the counter. Subsequently these bottles were mounted on a caster, and later they were inverted, mounted in rings upon a marble slab, and stopped from within by a valve upon the end of a rod which projected through a hole in the top of the inverted bottle.

The apparatus for manufacturing soda-water described above, with various modifications and improvements, is that most generally used to-day throughout the United States, and nearly all manufacturers use marble-dust and sulphuric acid for the production of carbonic-acid gas.

In 1844, A. D. Puffer, of Boston, began the manufacture of soda-water apparatus, and probably about the same time A. J. Morse, who in his day was one of Boston's leading coppersmiths, took up this branch of manufacture. Puffer invented the first cooler for soda-water upon which a patent was granted, and Morse manufactured a vertical copper generator and portable copper fountains or tanks

for holding and transporting the beverage. In 1847, William Gee, of New York, who had been an apprentice under Matthews, established himself in business. He was an ingenious mechanic, and patented many minor devices in soda-water machinery and apparatus.

To G. D. Dows, an Englishman, who carried on a drug business in Boston, belongs the honor of inventing and patenting the first marble soda-water apparatus, the prototype of the modern soda-fountain. He began business in 1854. His apparatus was a marble box, containing a coil-pipe cooler for soda-water, and metal containers for syrups, and an ice-shaver, in which a block of ice was shaved into snow, the syrups and soda-water being drawn in a tumbler previously partly filled with shaved ice. This apparatus was distinguished by a row of silver-plated syrup-faucets, upon each of which an eagle was perched, serving as a lever for opening the faucet. His soda draft-tubes were provided with nozzles of soft rubber, which served to retain the gas in the water while being transferred to a water-bottle held against the rubber nozzle, the water being subsequently poured from the bottle into a tumbler containing the ice and syrups.

Later he invented the first double-stream soda draft-tube, which delivered the soda directly into the tumbler, thus doing away with the use of the bottle. This draft-tube furnished a fine forcible stream which stirred up the ice and syrup, and was provided with a "spoon" pivoted in the edge of the nozzle, which, when the tumbler was pressed against its projecting end, was forced beneath an inner nozzle, breaking the force of the fine stream and producing a large stream without force, which retained gas in the water without intervention of the water-bottle. Dows exhibited his apparatus at the Paris Exposition of 1867, and received medals and high commendation. About this time he established a branch house in London, which is still in existence. He was the first to manufacture a fine article of bottled ginger-ale in this country, and much of that now manufactured is made upon his formula. Among his early customers were Z. S. Sampson, of Court and Hanover streets, Boston, and Orlando Tompkins, who kept a drug-store at the corner of Washington and Winter streets, and who was the father of Eugene Tompkins, proprietor of the Boston Theater.

In 1863, being in need of a soda-fountain for use in my drug-store in Somerville, Mass., I invented and patented an apparatus styled the "Arctic," which subsequently attained a wide popularity, and led me to abandon the drug business to engage in its manufacture. Although a crude machine judged by modern standards, it was considered to be in advance of any in the market at that date. Its peculiar features consisted of cylindrical metal coolers, which possessed the advantage of producing soda-water of so low a temperature that the use of shaved ice, which had the effect of driving off the gas from soda-water drawn upon it, could be dispensed with. The syrup-containers were placed in the rear of the marble box, and connected with the syrup-faucets by means of coolers passing beneath the ice, producing chilled syrups. Syrup-faucets bearing a star and liberty-cap, doubtless remembered by many readers, distinguished this apparatus, which was noted for the coldness and consequent good quality of the beverage drawn from it.

My first catalogue was issued in 1864 from a little factory at 11 Haverhill Street, Boston, and was illustrated with woodcuts made by Kilburn, Boston's leading wood-engraver. It is curious to read in this book, in the light of subsequent developments, the statement of a conservative druggist: "Folks don't drink soda nowadays." Among my first customers were Henry C. Choate and John I. Brown & Son, leading druggists of Boston, and Southmayd, the leading confectioner of the city; also Ellis F. Miller, of Hanover and Union streets, a location which is still one of the leading soda-water stands of the city.

About this time Puffer introduced his apparatus with the "magic" draft-tube, from which soda-water and a variety of syrups were drawn through the same nozzle. This apparatus attained a wide popularity, and is known to New-Yorkers through its use by the celebrated Hudnut. During the years 1864, 1865, 1866, and 1867 my business extended, covering a wide range of territory; Frederick Stearns, of Detroit, F. E. Suire & Company, of Cincinnati, then the largest retailers of soda-water in the country, and Charles Lippincott, the largest soda-water manufacturer in Philadelphia, being among the users of and dealers in the "Arctic." The Lippincott business, which was established in 1832, subsequently took up the manufacture of marble soda-water apparatus, becoming one of the leading manufacturing houses in the line.

At this time, E. Bigelow, of Springfield, Mass., was manufacturing an apparatus which had at least one excellent feature—the "wonder" cooler, subsequently purchased, with other effects of the Bigelow Manufacturing Company, by John Matthews, on the failure of the company. The Bigelow apparatus was supplied with a piston-style faucet,

which proved unsatisfactory and went into disuse when this company discontinued business. The Bigelow apparatus was in use by Hegeman & Company, of New York, in 1865.

In 1854, and subsequently, many inventions of both the elder and younger John Matthews were patented; among others the measuring syrup-tank of glass, still used by their successors. William Gee invented and patented the two-wheel soda draft-tube, the pipe-lined coupling, a blow-off cock for generators, and other devices, which subsequently, by purchase, became the property of the Matthews concern. This ingenious mechanic received a patent for the combination of a force-pump with a soda-fountain, for forcing water into the fountain against pressure, thus preventing the waste of gas consequent upon opening the fountain to refill with water; and this invention is the basis of the present splendid machine for filling portable fountains made by the Matthews Company. Another of his inventions is the draft apparatus of silver plate, made popular by Huyler, the confectioner, and used at all his stores. This apparatus, known as the "Monitor Crystal Spa," and made by the Matthews Company, consists of a central cylinder containing coolers and syrups, surrounded by a revolving caster supporting an array of glass syrup-bottles. Gee's manufacturing apparatus was used by the celebrated Dr. Hanbury Smith, of Union Square, New York, and his bottling apparatus by Comstock, Gove & Company, of Boston. John Matthews is referred to in the New York "Evening Mail," in 1868, as the "Neptune of the trade," and is stated to have the largest house in the business, employing 100 men and carrying on no less than sixteen distinct trades, the factory at First Avenue, Twenty-sixth and Twenty-seventh streets, where it is still located, supplying everything in the soda-water line, from a quart of syrup to a $1400 apparatus.

In 1868 my apparatuses were already being imitated by rival manufacturers, and from that time on the competition has been sharp. The first departure from the square white marble box was made by me in 1869, when the cottage style was introduced, and the design patented. Colored marbles were used in this design, the Tennessee, Vermont, and New York State marbles being used in addition to the white Italian. In this year I introduced the patent revolving tumbler-washer, and began the use of block-tin syrup-cans, which were a great advance in purity and durability over the syrup receptacles of copper, glass, and earthenware previously in use. In this year, also, I had the satisfaction of selling one of my fountains to Copeland & Tarbell, of Boston, who had at that time the finest confectionery establishment in the United States.

Joseph Hindermyer, of Philadelphia, was one of the early manufacturers of soda-water apparatus, and many ingenious devices originated with him. Among his appliances which came into general use was the ground-plug syrup-faucet, which, with many improvements and modifications, is still used by the majority of manufacturers of soda-fountains. At this time there were 1200 of my fountains in use, and I opened my first branch at Maiden Lane and Nassau Street, New York. In 1873 the first hot-soda apparatus was patented, and in 1874 a sliding valve, double-stream draft-tube, and the cup-cooler, the latter still being used in all apparatus of my make. In 1874, also, the first patent was granted under which the Matthews steel fountain was manufactured. The introduction of the steel fountain marked an era in the business, it being a vast improvement over the so-called portable cast-iron fountains, or even the lighter copper fountains, once so common and now so seldom seen.

The Centennial Exhibition at Philadelphia afforded an opportunity not to be overlooked for advertising the soda-fountain and popularizing soda-water as a beverage, and the exclusive privilege of serving it within the grounds was secured by Charles Lippincott & Company and myself for the sum of $50,000. The business done was enormous, and, although not profitable in itself, proved a valuable advertisement. Puffer in this year invented the arc, a small silver-plated counter apparatus, which has proved very popular; and Gee invented a self-closing acid-valve for carbonic-acid-gas generators.

Matthews in 1878 invented the solid-plunger syrup-pump, which, with modifications, is still extremely popular with bottlers of soda-water; and in 1880 the "sublift" syrup-valve for glass syrup-tanks, provided with measuring chambers, which form the distinguishing feature of this make of dispensing apparatus. In 1881 Matthews was granted the first of a series of patents for filling portable fountains with soda-water, which formed the basis of the so-called "new system" now coming into general use. Puffer in 1882 invented and introduced the revolving water-gauge, and the same year introduced the patented pressure-regulator, a useful device for preventing breakage of bottles when being filled with soda-water, lessening danger to operators from flying fragments of glass, and improving the uniformity of beverages. Roger Scannell, of Boston, in 1884 patented the first spray-carbonator, a simple

JAMES W. TUFTS.

and efficient device for combining gas with water without mechanical agitation.

An era of the business was marked again in 1885 by the invention of the drawer syrup-can, which was patented and introduced by me. This syrup-can, which differs from all that have preceded it in being horizontal and located below the ice-chamber, has become so popular that it has practically driven every other form of syrup-can from the market. Numerous patents have been granted upon imitations of it, and several suits for infringements are now before the courts. The heat-regulator used on my hot-soda apparatus was invented and patented in this year.

In 1886, Harry Robertson, of New York, patented a spray-carbonator containing some ingenious automatic features, which is manufactured by Witteman Brothers, of New York. In 1887, William P. Clark, of Medford, Mass., invented the latest of a series of double-stream draft-tubes, which were for many years, and are still, used exclusively on my fountains. This tube, which is a nice piece of mechanical construction, may be entirely taken apart without the use of a wrench, and draws alternately fine and large streams of soda by slight movements of a lever. Luther W. Puffer patented the non-clogging blow-off cock for generators in 1887, and F. Hazard Lippincott patented a removable glass syrup-jar, with a simple and ingenious device for detaching the cock from its lever by simply lifting it with the jar in removing the latter.

Early in 1891 the proprietors of the four largest concerns engaged in the manufacture of soda-water apparatus came together and organized the American Soda-Fountain Company, which purchased from the owners, at fair valuations, the four businesses represented. The company is capitalized at $3,750,000, one third of which is first preferred stock, bearing six per cent. dividend; one third second preferred stock, bearing eight per cent. dividend; and one third common, which to date has paid ten per cent., while a surplus of $300,000 has been laid aside. The company conducts its four branches as separate and distinct businesses under the old firm names of James W. Tufts, A. D. Puffer & Sons, Charles Lippincott & Company, and the John Matthews Apparatus Company. It has recently acquired by purchase the Hartt Manufacturing Company, of Chicago. The stock of the American Soda-Fountain Company is held by some 800 different owners.

The Hartt Manufacturing Company patented and introduced in 1891 a drawer-can which is dropped before withdrawing. This patent has already become a source of litigation, two suits for infringement having been brought under it. Henry Carse, of Rock Island, Ill., in 1892 patented a carbonating-machine for combining carbonic-acid gas and water by the spray process, which was introduced by the Hartt Manufacturing Company, and has attained considerable popularity. The Low Art Tile Company, of Chelsea, Mass., took up the manufacture of soda-fountains in 1891, abandoning its older business of manufacturing tiles for architectural and decorative purposes, and produced the first apparatus incased entirely in tiles.

F. H. Lippincott in 1893 patented the first tilting syrup-jar, which was closely followed by a similar device invented and patented by Herman Hoff, of the Hartt Manufacturing Company; and the same year I patented the "Cataract," the latest and most improved form of spray-carbonator. In this machine gas is admitted under high pressure to a vertical chamber, through a regulating valve which maintains a uniform pressure; by means of a pump, water is forced into the top of this chamber through a plate perforated with hundreds of tiny holes; and a revolving agitator in the lower part of the chamber completes the combination of gas and water. The quantity of water is governed by the action of a small vessel hung in knife-edge bearings and counterbalanced, the water flowing and ebbing in the vessel as its level varies in the mixing chamber, and gravity causing the vessel to rise and fall as its weight varies with the changing flow of water. The rock-shaft, upon which the vessel and its counterpoise are mounted, carries a belt-shipper, and its movement ships the driving-belt of the pump from the fast to the loose pulley, and vice versa, thereby alternately stopping and starting the pump. The action of this machine is entirely automatic, and adapts its output to the demand made upon it by the bottlers, working equally well whether supplying one or six bottling tables. I have recently completed for the Charles E. Hires Company, of Philadelphia, a machine consisting of three of these carbonators mounted in battery with two generators of the largest size, which is capable of supplying eighteen bottlers and turning out 3600 dozen bottles of beverage in ten hours. This is probably the largest machine in the world for the manufacture of soda-water.

Besides the patents described, hundreds of others have been granted for soda-water machinery, the American Soda-Fountain Company alone owning nearly 200 live patents. In addition to those mentioned previously in this article, there are scattered

throughout the country numerous other concerns manufacturing soda-fountains, among which may be mentioned Otto Zweitusch, of Milwaukee; Bennett & Gompers, of New York; and the Robert M. Green Company, of Philadelphia. Wrought-iron portable fountains are also manufactured by the Iron-Clad Can Company, of Brooklyn.

The amount of capital invested in the business is hard to estimate, and also the number of people employed. The capital of the American Soda-Fountain Company has already been stated, and this company employs nearly 1000 hands, in addition to a force of about 125 traveling salesmen. The number of soda-fountains in use is estimated at from 50,000 to 60,000. Fully this number have been made and sold by the various concerns now forming branches of the American Soda-Fountain Company, and of these the majority are still in use. The dispensing fountains, which are generally made from foreign marbles, many being of rare Mexican onyx, vary in value from $100 to $10,000 each, bottling outfits of cast-iron and copper ranging at about the same values. The business annually done by the users of these fountains takes about the same range, though in exceptional cases it is much larger. Plows, who until recently was the leading dispenser in Chicago, sold $24,000 worth of carbonated beverages in a single year.

Without doubt the large consumption of this wholesome and agreeable beverage has an influence in promoting temperate habits among the people of the United States, by lessening the consumption of alcoholic drinks. That the use of soda-water increases largely year by year is shown by the annual sale of several thousand of the practically indestructible steel fountains used as portable containers. As a source of profit the soda-fountain contributes largely to the prosperity of its owner, and no retail drug or confectionery store can lay claim to be well appointed that is not supplied with one. The business of manufacturing soda-water apparatus is in a prosperous condition, and its prospects for the future are bright, although competition has forced prices to such a point that profitable business can be done only upon a large scale, involving the investment of enormous capital in plant and labor-saving appliances.

The cost of selling and collection is large, and payments are made in non-negotiable lien notes, and it is only by making them in very large numbers that soda-fountains can be profitably manufactured. The collateral branches, which include the manufacture of fruit-juices, flavoring extracts, syrups, bottlers' supplies, and the silver-plated furnishings of the soda-water counter, are in a flourishing condition. In conclusion I may say that soda-water, which a few years ago was a novelty and luxury, is now looked upon as a necessity, and bottled waters, plain and salted, as well as ginger-ale and similar sweetened carbonated beverages, are now commonly found upon the tables of a large percentage of our people.

James W. Tufts

CHAPTER LXXII

AMERICAN TEXTILE MILLS

ONE hundred years ago there were no textile mills, as we now understand the term, in the United States. Whatever our people did in the way of manufacturing their own clothing was mostly done in the household; the spinning-wheel and the hand-loom were utensils as familiar in the old-fashioned kitchens as the pots and kettles of the housewife. The homespun garments worn by our forefathers were fashioned out of wool grown on the home farm, carded by hand-cards, washed in tubs, spun and woven by hand, fulled and finished at home, cut up and sewed—all by the joint labor of husband, wife, sons, and daughters. The finer clothes worn in those days were all imported; and as the colonies grew and multiplied, and their consumption of English textiles increased, the manufacturers of the mother country foresaw a wondrous new market opening up before them. The desire to retain and increase that market for textiles, in the manufacture of which England already led the world, was far more prominent among the causes leading up to the American Revolution than the historians of that event have yet discovered.

The homespun garments of colonial days were plain in weave, and wore like iron; their ingredients were indicated in the name commonly applied to the cloth—"linsey-woolsey." It was a fabric of woolen weft, woven on a linen warp. Linen was much more commonly produced in the household than cotton fabrics, and wool was more in use than all other fibers combined. Cotton was a scarce commodity in colonial America until long after the Revolution. It possessed a value equal to that of wool, and sometimes very much higher. What little of it was used prior to the nineteenth century was mostly imported from the Barbadoes. When Samuel Slater started the first American cotton-mill at Pawtucket, in 1793, he insisted upon using cotton from the Indies, because of the poor quality of the cotton then raised at home. No one dreamed, when the "Shipping and Commercial List and New York Price Current" first made its appearance, that America was destined to become the cotton-producing country of the world; nor did Slater's little mill of 250 spindles, which had then been in operation five years, give signs that it was the germ of an American industry which would consume annually within 100 years more cotton than all the world was then growing. The history of the textile industries during the colonial period is nowhere suggestive of the development which confronts and amazes the student at the close of the nineteenth century, who finds them, with their subsidiary industries, employing more capital and creating a greater value of annual product than any other group.

Our forefathers realized how important it was that the colonists should learn to clothe themselves. They resorted to all sorts of expedients, some of which smack strongly of state socialism, to overcome the difficulties in the way. They offered bounties to increase the number of sheep and promote the growth of flax. In Massachusetts laws were passed making it compulsory that each family should spin a given quantity of yarn every year, under penalties of heavy fines. Gradually the household textile industries assumed an importance which alarmed the mother country, and the Lords of Trade attempted by various restrictive orders to prevent and harass a development which threatened to destroy the colonial market for the chief products of British industry. Parliament passed an act in 1774—which was shortly after the Arkwright inventions had inaugurated the modern factory system—forbidding the exportation, under heavy penalties, of any of the machines used in the cotton, silk, woolen, or linen manufacture. One smiles, in recalling this statute,—which remained in force, with certain modifications, until 1845,—at this evidence of a puerile hope that the English people could keep the fruits of inventive genius bottled up in their little island, so long as she

permitted her sons to carry their brains across the water. Slater brought his spinning machinery in his head; in the same way Arthur Scholfield, three years later, brought the first wool-carding machine, which he built and put into operation at Byfield, Mass., in 1794, thus fixing the date of the beginning of the factory manufacture of wool, by machinery operated by power, in the United States. American machinists and inventors did the rest.

It is not to be denied, however, that this English statute did retard, embarrass, and make trebly difficult the early development of our textile factories. At the founding of the newspaper whose century of existence is celebrated in this volume, the American textile industries were easily one hundred years behind those of Great Britain.

It would be interesting, if space permitted, to follow the evolution of this household industry, by slow and gradual steps, into the highly organized factory system which marks the close of the nineteenth century. First came the neighborhood fulling-mill, utilizing the friendly services of the adjacent stream, and relieving the housewife of the labor of fulling and finishing the cloths and blankets accumulated by the busy shuttle during the long winter evenings. Then the carding-machine was added to the fulling-mill; the farmers for miles about brought their wool to be converted into rolls ready for the spinning-wheel. After Slater had successfully applied the Arkwright invention to the spinning of cotton at Pawtucket, here and there throughout New England little mills gradually appeared which spun both cotton and woolen yarns by water-power. Hand-looms were still used in all these mills until 1813, when Francis C. Lowell's invention of the power-loom led to the building of the Waltham cotton factory by the Boston Manufacturing Company, and the American textile mill first took on the characteristics which have since increasingly distinguished it.

Power spinning and weaving machines were rapidly applied to the manufacture of woolens, and it began to be seen that the household manufacture of textiles was disappearing before the greater economy and efficiency of the factory system. The transition was not rapid, and the ups and downs of our first textile mills were numerous and discouraging. The outbreak of the War of 1812, and the non-intercourse acts and Embargo which preceded it, were the most potent factors in completing the transition. The total suspension of importations threw our people suddenly upon their own resources for their entire supply of clothing. Cotton-mills and woolen-mills were quickly built. High prices and the promise of quick fortunes drew many men with little or no knowledge of manufacturing into the business.

All went well enough until the war ended; then collapse and ruin followed apace. The work of laying the solid foundations of textile manufacturing had all to be done over again. Imported cottons and woolens again invaded the market with a rush, and the domestic manufacturers found it impossible to compete with them either in quality or in price. Labor was unskilled and hard to get; knowledge and experience were sadly wanting; machinery was clumsy and defective; the country was poverty-stricken, and trade and the national finances thoroughly demoralized. Then first began the great battle in Congress, which has waged more or less intermittently ever since, for the protection of the domestic manufactures by means of tariff laws. The Tariff Act of 1816—the first of the series in which the principle of protection was recognized in the rates fixed as a distinct purpose of the law, conjointly with the raising of revenue—was much more favorable to the cotton than to the wool manufacture, because it applied the minimum principle to cotton cloths, which was in effect a specific duty of six and one quarter cents a yard, while the simple ad valorem rate of twenty-five per cent. was applied generally to woolen goods.

From the date of that law the cotton manufacture began a healthy development, and it naturally grew much faster than the wool manufacture. The later tariffs were in like degree, as a rule, more favorable to cottons than to woolens; partly owing to this fact and partly to other causes, such as the much more delicate, complicated, and expensive operations incident to the latter, the cotton manufacture has, at all times except during the Civil War, shown a greater prosperity, and on the whole a more rapid development, than its sister industry. But in both industries for many years it was an uphill struggle against great odds. Few fortunes were made; many were lost; and the courage and tenacity of those early textile manufacturers are worthy of a better eulogy than any yet written.

Since the year 1850 the development of our textile industries has been pretty accurately recorded by the Federal census, and it is therefore possible to measure, from that date, the degree and the character of the development. To give the reader a bird's-eye view of the growth of American textile mills in the last fifty years I reproduce here a table prepared by me for the Eleventh Census, in which the statistics of the three principal textile industries

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are presented chronologically in comparison with one another, and in a form more condensed than I have seen it elsewhere given. This table offers nearly everything in the nature of statistics with which it is necessary to burden this paper.

of the country, we have an additional product, as shown by the Eleventh Census, of $413,022,516; making the total value of the products of our textile mills, when they finally reach the market, the enormous sum of $1,134,971,778. This total is the

COMPARATIVE STATEMENT OF COMBINED TEXTILE INDUSTRIES IN THE UNITED STATES, 1850 TO 1890.

Industries.	Year.	Number of Establishments.	Capital.	Average Number of Employees and Total Wages.		Cost of Materials Used.	Value of Products.
				Employees.	Wages.		
Wool manufacture [1]	1850	1,760	$32,516,366	47,763	[2]	$29,246,696	$49,636,881
Cotton manufacture	1850	1,094	74,500,931	92,286	[2]	34,835,056	61,869,184
Silk manufacture	1850	67	678,300	1,743	[2]	1,093,860	1,809,476
Dyeing and finishing textiles	1850	104	4,818,350	5,105	[2]	11,540,347	15,454,430
Combined textiles	1850	3,025	112,513,947	146,897	[2]	76,715,959	128,769,971
Wool manufacture [1]	1860	1,673	42,849,932	59,522	$13,361,602	46,649,365	80,734,606
Cotton manufacture	1860	1,091	98,585,269	122,028	23,940,108	57,285,534	115,681,774
Silk manufacture	1860	139	2,926,980	5,435	1,050,224	3,901,777	6,607,771
Dyeing and finishing textiles	1860	124	5,718,671	7,097	2,001,528	5,005,435	11,716,463
Combined textiles	1860	3,027	150,080,852	194,082	40,353,462	112,842,111	214,740,614
Wool manufacture [1]	1870	3,456	132,382,319	119,859	40,357,235	134,154,615	217,668,826
Cotton manufacture	1870	956	140,706,291	135,369	39,044,132	111,736,936	177,489,739
Silk manufacture	1870	86	6,231,130	6,649	1,942,286	7,817,559	12,210,662
Dyeing and finishing textiles	1870	292	18,374,503	13,006	5,221,538	[2] 99,539,992	[3] 113,017,537
Combined textiles	1870	4,790	297,694,243	274,943	86,565,191	353,249,102	520,386,764
Wool manufacture [1]	1880	2,689	159,091,869	161,557	47,389,087	164,371,551	267,252,913
Cotton manufacture	1880	756	208,280,346	[3] 174,659	42,040,510	102,206,347	192,090,110
Silk manufacture	1880	382	19,125,300	31,337	9,146,705	22,467,701	41,033,045
Dyeing and finishing textiles	1880	191	26,223,981	16,698	6,474,364	13,664,295	32,297,420
Combined textiles	1880	4,018	412,721,496	384,251	105,050,666	302,709,894	532,673,488
Wool manufacture [1]	1890	2,489	296,494,481	219,132	76,660,742	203,095,572	337,768,524
Cotton manufacture	1890	905	354,020,843	221,585	69,489,272	154,912,979	267,981,724
Silk manufacture	1890	472	51,007,537	50,913	19,680,318	51,004,425	87,298,454
Dyeing and finishing textiles	1890	248	38,450,800	20,267	9,717,011	12,385,220	28,900,560
Combined textiles	1890	4,114	739,973,661	511,897	175,547,343	421,398,196	721,949,262

[1] Includes hosiery and knit goods.
[2] This item was not fully reported in the census of 1850.
[3] At the census of 1870 the value of the fabric itself was included, whereas in all subsequent censuses merely the values added to such fabrics by processes of dyeing and finishing are given.

Here we find, in the half-century, a growth in the value of products from $128,769,971, in 1850, to $721,949,262, an increase of nearly six times, and not less than ten times if it were possible to measure this product by quantity instead of by value. Even these figures convey an inadequate idea of the relative importance of our textile mills in the industrial economy of the nation, for these mills supply the materials for a great group of subsidiary factory industries, such as the wholesale clothing manufacture, the shirt manufacture, etc. When we aggregate these, and add to them the value of the products of the linen, jute, hemp, and bagging mills

largest in value of any single line of related industries. The total most nearly approaching it is that of the iron and steel industries, the multiform variations of which reveal a value of products, when aggregated from the census tables, of $1,096,163,056. These two industries include, therefore, two ninths of the total value of all the domestic manufactures reported by the Eleventh Census; and those of the textile mills and the factory products growing out of them are equal in value to one ninth of all our manufactures. Figures of this magnitude bring us face to face with the true relative importance of our textile mills in the industrial economy

of the nation. Few people realize how vast and how varied it is; for they do not stop to think that, next to the food question, nothing comes so closely home to all the people as the question of what they shall wear.

The decrease in the cost of goods during the period covered by this table has been one of the most striking phases of the development. Unfortunately it is not a phase which statisticians have learned to measure in figures. This decrease in the cost of textile goods is due in some measure, of course, to the decreased price of the raw materials from which they are made; but in even larger measure is it due to the remarkable advance in the methods of manufacture—to the new and more perfect machinery employed, in the invention of which American mechanical genius has contributed certainly as much as any other people, and perhaps more.

All the fundamental inventions in spinning machinery were of English origin; so was the combing-machine and the power-loom. The English have a remarkable record in this respect, and the French and the Germans have also done much in the invention of labor-saving textile machinery. But the American record surpasses them all, in my judgment. The wool-carding machinery of all countries owes its chief improvement over the machines of a century ago to the invention of John Goulding, of Worcester, Mass., whose patent, dated 1826, dispensed with the splicing-billy and produced the endless roll or sliver. Michel Alcan, the distinguished French writer, describes it as "the most important advance in the wool manufacture of the nineteenth century." "It was not a step," he says, "but a flight."

The modern cotton-spindle, making 10,000 revolutions a minute, is an evolution of our own mechanics. General Draper, in his interesting paper on "The History of Spindles," has shown that the saving effected by the new forms of spindle invented and adopted in the United States since 1870, when 5000 revolutions a minute were the average speed, has been more than equal to the capacity of all the warp-spinning machinery in use in this country in that year. He adds the interesting fact that "to-day more than three times as much warp-yarn is spun in the United States as in 1870, a rate of increase without parallel since the earliest introduction of the cotton manufacture."

The Lowell loom was the first successful application of power to the weaving of cotton, the Crompton loom to the weaving of fancy woolens, and the Bigelow loom to the weaving of carpets. "Not a yard of fancy woolens," wrote Samuel Lawrence, "had ever been woven by power-looms in any country until it was done by George Crompton at the Middlesex Mills in 1840." Every carpet ever woven was woven by hand until Mr. Bigelow's power-loom revolutionized the industry. Beyond these fundamental machines the American mechanisms for expediting processes, for automatic devices, for dispensing with intermediate help, have been so numerous that they have completely transformed the *modus operandi* of textile mills throughout the world. These mechanisms are more generally in use to-day in the best American textile mills than in those of any other country. So far as mechanical equipment is concerned, our best mills, whether cotton or woolen, are fairly equal to the best in any foreign country.

It does not follow that textile manufacturing is done here, as a rule, with equal economy in cost; some of the reasons for this may be pointed out later. In structural equipment the modern American mill is in some respects superior to the average foreign mill. It is not so massive a structure, nor so solidly built, we using brick when the English generally use stone; but in the lightness and airiness of its rooms, in economy of arrangement, and in general completeness of equipment and care for the comfort and convenience of the operatives, it is generally superior. Since Mr. Edward Atkinson's successful efforts to introduce the slow-combustion construction, the liability to loss by fire is hardly greater, as the insurance statistics show, than it is abroad. Of course there are left many old-fashioned mill structures, built long ago, and often of wood, to which these remarks do not apply. But the lesson is fast being learned by our textile manufacturers that in these days of close competition and small profits successful manufacturing requires that buildings shall be of the latest design and the most approved arrangement, and machinery shall be not only modern in make, with every latest improvement, but must also be kept in perfect condition by constant renewal. Many parts of the machinery required for the equipment of our textile mills are still necessarily imported from England, because not made, or less perfectly made, in the United States. This is true of some varieties of cotton machinery, and of most of the preparatory machinery of the worsted manufacture. Our machine manufacturers have been advancing as rapidly in recent years as the textile mills themselves, and the time cannot now be far distant when every new mill built in America will be equipped throughout with American-made machinery.

The American textile mills now supply practically every variety of fabric made in the world, with the exception of linens and the very finest grades of other fabrics. In a single branch of textile manufacturing—flax—our efforts have been a failure by the test of experience, and are likely to continue a failure. But three establishments making linen goods reported to the last census, showing a capital of $900,000, and products valued at $547,278. These products were chiefly thread and twine, the latter for use in the shoe manufacture. Except crash goods, there are now no linen fabrics of any moment manufactured here. Great sums of money have from time to time been invested by daring manufacturers in constructing plants for the manufacture of linen fabrics. The result has invariably been disappointment and failure. If the obstacles were of a kind that ingenuity and perseverance could overcome, they would have been conquered. These obstacles are climatic in the first instance, flax being a fiber which requires more moisture than any other for its successful manipulation. Again, there is difficulty in obtaining a home supply of suitable raw material. Years of high protection have failed to persuade the American farmer into growing flax for fiber. The care, the skill, the trained labor required to grow and separate the best quality of fiber, discourage him, and the absence of any considerable home market removes the inducement which tariff protection would otherwise afford. The history of the linen manufacture in other countries seems to establish the fact that it is the one textile manufacture likely to remain segregated in a few localities like Holland and Ireland, where the fiber is grown on the spot, where the climate is peculiarly adapted, and where the help has acquired an expertness born of generations of experience. Moreover, linen is the one textile the consumption of which has not appreciably increased with the growing perfection of textile machinery. The quantity of linen fabrics made to-day is hardly larger than a century ago. The other fibers, less difficult to handle, more susceptible to cheap manipulation, continually encroach upon its uses.

Turning from this single failure, we find extraordinary success in every other department of textile manufacturing. Perhaps the most striking contrast to our experience with linen is that afforded by the silk manufacture. At first sight it would appear that this must be the particular textile industry which could not flourish in America. Since the whirlwind of speculative excitement over the culture of the silkworm which swept New England in the thirties, and wrecked the fortunes of many too credulous farmers, we have settled down to the conviction that America cannot grow raw silk in competition with China, Japan, and Italy. Moreover, the silk manufacture, like the linen, has always been highly specialized and localized. The city of Lyons, in France, had well-nigh monopolized the manufacture, so far as it had escaped from the hand processes of the Eastern nations. The skill and taste of generations have been concentrated upon the production at these centers of fabrics which in beauty of design, in richness of coloring, in delicacy of workmanship, alone among the fabrics made by modern machinery, rival the splendors of medieval textile art. England has for centuries struggled in vain to place her silk manufacture on equal terms with it. Nevertheless we have built up in America, in the last forty years, a silk industry which among machine-using nations is second only to that of France, and is to-day supplying our people with the bulk of the silken fabrics consumed by them.

We owe this great achievement largely to the energy and the genius of the Cheney family, father and sons, of South Manchester, Conn. The Cheneys began the manufacture of spun silk about forty years ago. About the same time, John Ryle, sometimes called the father of the American silk industry, had become superintendent of a little silk-mill in Paterson, N. J., which he afterward purchased and gradually enlarged. At first sewing-silks only were made, then ribbons were added, and in 1842 Mr. Ryle built a number of looms for silk piece-goods—the first to be successfully operated in America; and the industry in all its branches has since developed so rapidly there that Paterson, which calls itself the Lyons of America, now occupies to this industry the same relation that Fall River does to the cotton manufacture, and Philadelphia to the wool manufacture.

During the Civil War the high duties stimulated the silk industry and diversified its product. The making of plain grosgrain dress silks was then started, and at the present time brocaded silks and satins are manufactured on a large scale; indeed, there is no form of fabric into which silk enters which is not now produced in great variety. Especially noteworthy has been the recent development in the manufacture of silk plushes and all varieties of upholstery goods. The value of home-made silk goods was in 1880 just about equal to the foreign value of the goods imported. In 1890 the product had so grown that it was more than double the value of the imports, and more than double the

value of the product in 1880. Mr. Briton Richardson, the secretary of the American Silk Association, has recently compiled statistics which show that in the five years since the census of 1890, the rate of increase has even accelerated. He points to one mill, erected in Paterson since that date, which is already the largest silk-ribbon mill in the world. There are other mills in that city, notably that of the Pioneer Silk Company, which is an outgrowth of the little mill operated by John Ryle, and now covers an acre and a half, which can nowhere be surpassed either in size or in completeness of equipment.

The cotton manufacture must, on the whole, be taken as the textile industry which best illustrates the possibilities of this group of manufactures in the United States. The number of cotton-spindles in operation in 1894 is estimated at 17,126,418, and this number has been considerably increased in 1895, particularly by new mills in the Piedmont region of the South. The manufacture is there conducted under so many advantages—particularly the cheapness of fuel and labor—that careful students of economic conditions predict that the manufacture of the coarser grades of cotton goods is destined to gravitate more and more to the Southern States.

New England, and especially Massachusetts (which is the largest cotton-manufacturing State, containing 7,160,480 out of the 17,126,418 spindles in operation), has done much to hasten and facilitate such a transfer by the enactment of harassing labor laws and by excessive taxation. She possesses no natural advantages for this particular industry, and her manufacturers have looked with some apprehension upon the rapid growth of the industry in the South, chiefly through the aid of New England capital. Thus far there has been no diminution in her machinery capacity, but, on the contrary, a steady increase, which, while relatively smaller than the increase in the South, continues to be actually greater. This is due primarily to the increased production of the finer grades of goods in New England, and, secondarily, to the rapid development of the country, with its enlargement of a market in which the South can share largely without injuring New England. Nevertheless the economic forces at work are of such a character that eventually a marked change in the geographical status of the industry seems inevitable.

From the national point of view, the important fact is that the growth of the American cotton manufacture for the last twenty years, both relatively and actually, has been greater than its growth in Great Britain, which reported at the last enumeration a total of 45,270,000 spindles. The whole of the remainder of Europe operates less than 30,000,000 spindles. These statistics place the American cotton manufacture second only to that of England, and reveal a steady gain even upon the island which manufactures cotton for all the world except the United States. The American market for American cottons constantly expands with the growth of our own country, while our foreign markets show little gain. The English market as steadily contracts, as English and native capital builds new cotton-mills in India and Japan for the supply of the vast markets of the East. The influence of this increasing competition, under circumstances which greatly handicap English manufacturers, is apparent in the values of the stocks of the Oldham Limited Companies, as they are quoted to-day, and in the gloomy talk of Lancashire manufacturers when they forecast the future. On the other hand, our own cotton manufacturers, as they emerge from the prolonged business depression, face the future with hope and courage.

The casual student of first-class English and American cotton-mills, while he will observe certain differences, will not be able to detect any point of superiority in the former over the latter. He will find the English mills much more closely specialized, and he will find a larger proportion of them engaged upon the finer grades of goods. He will observe, also, that in the English mill mule-spinning is the predominating method, especially for fine numbers; while in the United States ring-spinning strongly predominates. In 1870 the proportion was nearly equal between the two systems in American mills, there being reported by the census of that year 3,694,477 frame-spindles and 3,437,938 in mules; in 1890 there were 8,824,617 frame-spindles and 5,363,486 in mules; and subsequent development has accentuated this disparity. This is due to the extraordinary advances, already alluded to, in the mechanism of the ring-spinning frame, advances which are wholly of American origin, and which greatly cheapen the cost of production by increasing the product in proportion to the increased speed of the spindle. In mule-spinning, also, great advances have been made during the last fifteen or twenty years. Whichever method is employed, the development of the industry has reached that stage where success depends upon the closest attention to the mechanical details of manufacturing. The margin of profit in print cloths, for instance, has come to depend upon the saving of a fraction of a cent in the price of a pound of cotton, and the economy of another small fraction of a cent in converting that

cotton into yarn and cloth. To realize these fractions, which mean profit or loss, machinery must be kept in the highest state of efficiency.

The improvements in spinning have been so rapid since 1870 that most of our large corporations have been compelled to replace their spinning-frames at least twice in that interval. The bulk of the frames now in operation have been introduced in the last ten years, and are of the highest efficiency. A similar statement can be made regarding no other branch of textile manufacture; and it is probably true that if the American woolen-mills had been forced, as the cotton-mills have been, to abandon machinery as soon as it became in any degree obsolete, their ability to face foreign competition would be more nearly in keeping with that shown by our cotton manufacturers. The conditions we have been narrating have thrown the cotton manufacture more and more into the hands of large corporations, which now almost universally conduct it. The wool manufacture, on the other hand, while it numbers some of the greatest corporations in the land, is still largely in the hands of individuals and partnerships, and the bulk of the mills are comparatively small in capacity. The more recent tendency in the wool manufacture, for obvious reasons, is strongly in the direction of the corporate form of management.

The quantity of fine cotton goods made in American mills continues to be very small in comparison with the whole production. Mr. Edward Stanwood, the expert who made the cotton report for the Eleventh Census, calculated that only 6.31 per cent. of the value of the total product could properly be classified as "fine or fancy woven goods"; and it follows that the bulk of our consumption of this class of cottons is still imported. In other words, there is ample room remaining for the further and higher development of the American cotton manufacture. Into this field we are entering with characteristic Yankee energy. Within comparatively few years mills have been successfully established in New England which spin yarns as fine as Nos. 150 or 200; and there are mills at New Bedford, Taunton, and elsewhere which make, in bewildering variety, fabrics as delicate in texture and as artistic in design and coloring as any which reach this country from the machine-using nations of Europe.

The range of products made in American wool factories is as wide as the multiform uses to which this most valuable of all the fibers is put. They divide themselves naturally into four great groups, leaving the hosiery and knit goods out of the classification: woolen-mills, worsted-mills, carpet-mills, and felting-mills. There are the various sub-classifications of spinning, weaving, dyeing, and finishing mills, although, as a rule, all these separate processes of the manufacture of wool continue to be carried on jointly in this country, as the related parts of the one operation of manufacturing. In this statement is embodied the chief point of difference existing to-day between the woolen-mills of America, and, in fact, all our textile mills, and those of England and the Continent. The reasons for it lie on the surface of things. The fact remains that American textile mills can never expect—the great body of them, at least—to successfully compete with foreign mills on terms which are fairly equal, apart from the difference in wages, until they have passed through the same evolution and approximated to the same methods which prevail abroad.

In so saying I am not passing a wholesale criticism upon our mills or their management. In the wool manufacture, as in the cotton and silk manufacture, we have many establishments which, in completeness of structure, in perfection of machinery, in all the details of mechanical equipment, and in sagacity of management, are nowhere in the world surpassed. Indeed, it is only in this country that we find, on a very large scale, textile mills in which are performed all the separate processes for the manufacture of great varieties of goods. Elsewhere they have learned that the greatest economy and the best practical results are secured by specializing the processes. Thus in Bradford, England, are enormous establishments which do nothing but comb wool into tops, either on commission or for sale. Other great mills do nothing but spin tops into yarn, and generally they confine their operations to a limited variety of yarns. Still others, buying their yarn, devote themselves exclusively to weaving. And, finally, a fourth class of establishments take the woven goods and dye and finish them for the merchants, who are the men who find the ultimate market for all the specialists who have been thus employed upon the goods.

In this specialization of the different branches of the work exists the characteristic distinction between the American and the foreign textile mills of to-day. Such investigation as I have been able to make of the two methods convinces me that the English is far superior to the American, and that ultimately we must gravitate into the former, if we are to cut any figure in competition for the world's markets. The manufacturer who devotes his whole energies to one particular thing, and studies to do that one thing as cheaply and as well as it can be done, can

do it better and more cheaply than the manufacturer who is doing half a dozen different things at the same time. This is not a theoretical deduction, but an axiom founded upon prolonged experiment and experience. I have talked with manufacturers in Bradford who have tried both methods, and who say there is always a gain in economy when the weaver buys his yarns, instead of spinning them himself. Obviously the English method requires a smaller investment in plant, secures a simpler and more perfect autonomy in operation, involves less waste, and avoids the accumulation of superfluous raw material.

The American woolen-mill was evolved from conditions which rendered this specialization originally impossible. It was situated in some isolated spot, drawn thither by a superior water-power, with no railroad to facilitate quick transportation, and was necessarily a complete mechanical entity, however crude its machinery. In a word, it must perform under one roof all the processes necessary to convert the greasy wool into the finished cloth ready for the market. Thus there sprang up all over the country little woolen-mills, each one independent in itself; as the country grew some of these little mills became large mills; other large mills grew up beside them; gradually we had centers in which the wool manufacture predominated; but conditions were long in appearing which tended to that specialization of processes which has marked the English method from the very introduction of automatic machinery. It followed that the American mill owner, even of a small mill, was compelled to make a variety of goods, in order to use up advantageously all the grades of material which grew out of the sorting of his wool. Naturally he could not produce a variety of products as cheaply and as successfully as he could have manufactured one particular line upon which his whole attention was centered. These habits of manufacturing, forced upon us originally by the logic of the situation, are tenacious. We have been slowly breaking away from them, but it will be years yet before it is possible to fully outgrow them. In Philadelphia, which is the largest center of wool manufacture, the progress of the evolution is very perceptible. There they have top makers, yarn makers, dyers, and finishers, who do nothing else. And the result is apparent in the large number of small manufacturers in that city. The small amount of capital required to equip a little weave-shed permits enterprising superintendents and operatives to start in business for themselves. The comparative cheapness of production under such conditions enables them to hold their own against the big establishments with unlimited capital at their back.

The bulk of the small wool-manufacturing establishments in the United States are woolen-mills proper, as distinguished from worsted-mills. It is noticeable that the number and product of these woolen-mills decrease from census to census as the worsted manufacture gets more firmly established here, and the more popular worsted fabric comes into wider use. But there are certain lines of woolen goods in the manufacture of which American mills have earned a world-wide preëminence, and in which they are nowhere surpassed. Prominent among them are flannels and blankets of every grade and variety. The American wools are peculiarly suited for these goods, and for many years past our American mills have practically supplied the home market. Other mills make a specialty of woolen dress-goods for ladies' wear with equal success. The bulk of our woolen-mills are, however, engaged upon the manufacture of cloths for the million—cassimeres, beavers, satinets, cheviots, etc., the cheaper grades which enter into the consumption of the wholesale clothing-houses, goods in which, under the weight duties of recent tariffs, our American manufacturers have controlled the home market, and of which their production has been enormous. Many of these goods are woven upon a cotton warp, and into some of them enters more or less of the revamped wool known as "shoddy." We have much to learn, however, in the handling of this class of materials, before we shall equal the expertness of foreign manufacturers. It is to the success of our manufacturers in producing a handsome, durable cloth at cheap prices, that our people chiefly owe their reputation of being the best-dressed people on the globe.

The worsted manufacture was late in getting lodgment in the United States, and has been slow in assuming proportions commensurate with its importance abroad. Early in the forties there were two or three large worsted-mills erected in New England for the production of worsted fabrics or stuff goods for women's wear; but the manufacture made little headway until after the close of the Civil War, and it was not until about 1870 that we began making men's-wear worsted goods. Since then the development of the manufacture along both lines has been phenomenal. In 1890 we made over 73,000,000 yards of worsted dress-goods, valued at over $76,-000,000; and we have to-day three or four mills, of the most modern equipment, which turn out these

goods in larger quantities than any foreign establishments.

In the manufacture of fine men's-wear goods, both in woolens and worsteds, a few of our mills have been equally successful; their products sell side by side with the best makes of foreign goods, notwithstanding the lingering prejudice among fashionable Americans that only foreign-made cloths are fit to wear. Another obstacle is the high cost of labor, which counts against us more strongly in fine-wool goods than in the cheaper grades, or in cottons and silks, because of the much greater care and skill and labor that must be bestowed upon their finishing.

The manufacture of felted wool is comparatively small here and elsewhere. Thirty-five American mills produced a product valued at $5,329,381 in 1890, and the importations are comparatively insignificant in volume. Felted wool was the earliest form into which this fiber was manufactured, the primitive races discovering, before they learned to spin and weave, that peculiar characteristic of wool which causes it to mat together, by the application of heat, moisture, and pressure, into a firm and smooth texture, susceptible of a great variety of uses. Modern machinery has utilized this peculiarity for many purposes which, while limited, are economically important. Table-cloths and floor-coverings, and hats for men's and women's wear, are the most ordinary; but they are also used for shoe-linings, sheathing materials, polishing purposes, etc. The hat manufacture, formerly confined to wool for its raw material, has found that fur is better suited for this use; and the processes of manufacture are so different from those employed in spinning and weaving mills that the hat-manufacturing establishments, in which the United States has always been preëminent, are not ordinarily classed among the textile mills.

Perhaps our most notable achievement in the textile line has been in the carpet manufacture. Beyond question the United States is the greatest carpet-manufacturing nation in the world; if we leave out of account the hand-loom productions of the Eastern countries we excel all others not only in the quantity of our production, but in the variety of our carpets, in the excellence of design and workmanship, and in general adaptability to popular needs. One hundred and seventy-three American carpet-mills produced in 1890 carpets and rugs to the value of $46,457,083, employing 11,223 power-looms. Their production included two- and three-ply ingrains, Brussels, moquettes, tapestries, velvets, Smyrnas, and the higher grades of Axminsters and Aubussons. This product represented an aggregate of over 76,000,000 square yards of carpeting, which enter into the annual consumption of the American people. The popular reason assigned for this unique development is the general prosperity of our people, the high wages earned permitting families of all grades of life to indulge in the luxury of floor-coverings to an extent elsewhere unknown. Stimulated by the lucrative market thus offered, American manufacturers have made larger and more important contributions to the mechanism of the carpet manufacture than those of all other nations combined.

The real development of the machine industry dates from the successful application of power to the weaving of ingrain carpets by the late Erastus B. Bigelow, of Boston, in 1844. Subsequently he invented Jacquard looms for weaving Brussels and Wiltons, which produced carpets pronounced by the jury at the London Exposition of 1851 to be "better and more perfectly woven than any hand-loom carpets that have ever come under the notice of the jury." A still later invention of Mr. Bigelow's was for weaving tapestry carpets. His inventions are at the base of all the power-loom carpet-weaving now done in Europe. Subsequent inventors have greatly improved them, and have added new inventions, such as those for weaving Axminsters, and Smyrna rugs. By their skill and enterprise the American carpet manufacturers have not only retained the control of their own market, except in the matter of the Eastern hand-made rugs, but they have in some instances successfully forced their products upon the European markets.

In one other branch of the textile industry progress in the United States has outstripped the world—the hosiery and knit-goods manufacture. More machine-made knitted goods are turned out annually here than in all other countries combined. The explanation is somewhat the same as in the case of carpets. Our people wear more underwear than other people; they are not only obliged to wear more for climatic reasons, but they can afford to wear more; and the general desire for personal comfort in wearing apparel results in an enormous distribution of the products of these mills. The beginnings of the industry are well within the lifetime of many manufacturers still living. Until 1832 the knitting of socks and stockings remained mostly a household industry—the only form of textile work which the machine had not wrested from the housewife. In that year Egbert Egberts successfully applied the principle of knitting by power, at Cohoes, N. Y.

His machine was simply the square stocking-frame of William Lee adapted to power. From that adaptation dates a revolution in underwear, which had previously consisted wholly of flannel, fashioned and sewed at home, according to the individual needs. The revolution gathered momentum gradually, as invention after invention—almost all of American origin—perfected the knitting-machine; but once the new industry was fairly and firmly established, it spread with amazing rapidity. In the decade between 1880 and 1890 the number of knit-goods mills doubled, and the value of the annual product jumped from $29,167,227 to $67,241,013.

The great variety of goods made facilitates the tendency, peculiar to this industry, toward the building of comparatively small mills, requiring but moderate capital; and it happens in consequence that these mills spring up all over the country, and can now be found in nearly every State. Many of them employ only cotton as a raw material; others use chiefly wool; and still others manufacture what are known as merino knit goods or mixed goods—cotton mixed with wool in proportions varying from fifty to seventy-five and ninety per cent. of cotton, according to the particular market sought. The tendency to the larger use of cotton in these goods is perceptible, not necessarily because of greater cheapness or a desire to adulterate, but because the liability of wool to shrink, and its excessive warmth, lead many to prefer undergarments in which cotton is an equal or predominating material.

In 1858 Mr. E. E. Kilbourne invented a machine for automatically knitting full-fashioned underwear; and this machine has gradually wrought a second revolution in the industry. The amount of hand labor now done is reduced to the minimum—to the mere sewing on of buttons, so to speak.

Having said much in this paper about the enterprise and mechanical ingenuity of American textile manufacturers, I may be pardoned for concluding with an allusion to an obvious deficiency, as applied to the industry as a whole. They have left little to be desired in the direction of cheapening textile products without deteriorating quality. They have built and equipped mills which rank with any in the world. They have planted on this continent machinery enough to supply all the textile wants of our people, except in a comparatively few lines of very fine fabrics. They have managed these mills with rare business sagacity, and as a rule with notable financial success. They have taken one specialty after another which had never been attempted here, and transported its manufacture from across the water, literally inventing anew the necessary machinery, as in the case of braids and plush goods, when they could not obtain it otherwise. They have taken these several textile industries, which have been localized and specialized in Europe for generations, and in less than half a century have made them one of the chief corner-stones of our national wealth. They have contributed far more than their share to the mechanical development which makes the labor of a single operative stand for that of a regiment of hand-workers in the eighteenth century. They have failed only in contributing their equal share to the artistic side of textile industry. They have been imitators instead of originators, although justice compels us to add that there are among them many striking and gratifying exceptions to this rule. But American-made goods do not bear, generally speaking, any distinctive artistic characteristics which distinguish them as American-made; and, generally speaking, they are inferior in this respect to the best products of foreign looms.

All this is natural—natural to a new country in which utility everywhere predominates over the ornamental. The next great forward step in our textile manufactures must be in the artistic rather than the mechanical direction, for there we recognize its weakest point. In the designing of patterns, in the use and application of dyes, in all that goes to impart to fabrics the artistic element, to lift the manufacture into an art, our textile mills are still far from the top of the ladder. This deficiency is not in any sense peculiar to the textile industries. It is an educational deficiency in which our people as a whole may be said to share. It is incidental to a crude country of limited facilities in art directions. What needs to be done is to supply those facilities; and the time is at hand when our manufacturers should themselves take the initiative in that work. All over Europe there exist technical schools for the training of textile workers,—weaving-schools, designing-schools, dyeing-schools,—in which those who manufacture goods are trained by the best instructors; and the result is not only better workmanship, but more beautiful and more artistic tissues. We have but one such institution in America—the Philadelphia Textile School, which is doing a noble work in elevating the standard and educating the taste of American manufacturers. We need more like it, need them badly, and need them at once.

S. N. D. North

CHAPTER LXXIII

AMERICAN CARPETS

A HUNDRED years ago very few woolen carpets were in use on Manhattan Island. A few wealthy people had Turkish rugs, and some ingrains were imported; but they were so rare that children were cautioned to tread lightly on them when permitted on state occasions to enter the carpeted room. No carpets were made here, except "rag carpets," the striped combination of rags and list which the Knickerbocker housewives wove at home, and which are still made in small quantities both in farm-houses and in factories. The first carpet dealers in New York of whom we know anything were J. Alexander & Company, whose advertisement in Parker's "New York Gazette; or, The Weekly Post-Boy," on Monday, June 30, 1760, reads as follows:

"J. Alexander & Company have removed their store to Mr Haynes's house on Smith St., where Mr Proctor, watch-maker, lately lived, where they sell Check Handkerchiefs, linens of different kinds, Lawn and Minonets, Scot's Carpets, broad and narrow cloths, Shoes of different kinds, made shirts, Hats, Stockings, with several other goods; Eine's Scot's barley and Herrings. Also a choice parcel of Old Madeira Wine in Pipes."

In the following year they offered for sale Turkey carpets, and two years later state that they "have imported some English and Scot's carpets and Hair Cloth for Stairs and Passages." They were then located "in the house right opposite Mr Donald Morison Ship Chandler House, betwix the Fly and Burling Slip." Judging from their advertisements in the papers of the day, they were not only the pioneers in the carpet business, but also the originators of the modern department store.

From this time on the use of carpets began to increase and the business to grow, until, according to the city directories, there were last year 304 firms engaged in the sale of carpets in New York and Brooklyn, the amount of capital invested being many millions. It was not until many years after carpets were first used in the colonies that the manufacture was introduced here, and the colonies had then become the United States. In 1791 William Sprague began to make Axminsters in Philadelphia. One of his first productions was a pattern which represented the coat-of-arms of the young Republic. The carpet was probably not wonderful, but it has achieved fame, not so much on account of the fact that it was our first attempt, as because it was the first article to which the principle of tariff protection was applied. Alexander Hamilton was Secretary of the Treasury, and in a report on manufactures sent to the House of Representatives in 1791 he recommended that a duty of two and one half per cent. be laid on carpets. To quote his own words: "To which the nature of the articles suggests no objection, and which may at the same time furnish a motive the more to the fabrication of them at home, toward which some beginnings have been made." (December 5, 1791.) The proceeds of this duty he proposed to use as a bounty to encourage the growth of wool in the United States.

Early in the century the manufacture of ingrains was begun, and has continued steadily increasing in amount ever since. Probably the first ingrain mill in the United States was that of George M. Conradt, who came to this country from the kingdom of Würtemberg, and settled in Frederick County, Maryland. The factory was a stone building, and was still standing not many years ago. The carpets were made in a hand-loom on a drum having rows of pegs somewhat like the cylinder of a music-box. This drum worked the harness. Jacquard's great invention was made in 1800, and soon after began to be applied to the weaving of carpets in this country. Among the early mills was one owned by Henry Burdett, which was located at Medway, Mass. Alexander Wright was the superintendent, and the concern is notable as having been the start-

ing-point of what became later the great corporation known as the Lowell Manufacturing Company, whose carpets afterward were the standard goods of the country. In 1825 Wright endeavored to gain information touching the jealously guarded secrets of the Jacquard machine, then in use in the manufacture of ingrains in Philadelphia, which city seems to have been the second starting-point for the manufacture of ingrains. He was unable to gain access to the mills, and sailed for Scotland, whence he soon returned with the best looms he could procure. He also brought over with him William and Glaude Wilson, to aid in operating the machinery. Glaude Wilson was a skilled mechanic, and devised improvements in the Jacquard loom, simplifying its construction and rendering it more certain in operation. He resided many years in Lowell, and lived to see the Lowell Company become one of the most important manufacturing establishments in the country.

While the Medway experiment was going on, a charter had been granted to the Lowell Manufacturing Company, and on February 22, 1828, its organization was completed. In those days directors' meetings were held at seven o'clock in the evening. Whitney, Cabot & Company were appointed to build the mills, employ the labor, and afterward sell the goods. The Medway mill and machinery were sold to the Lowell Company, which kept the looms in operation in that place until its own factory at Lowell was finished. Alexander Wright, referred to above, was the first superintendent. For a long time the enterprise was regarded as an experiment, and many believed that the demand for carpets would not justify paying for the skill necessary to make them. The hand-looms of those days were by no means as perfect as the hand-looms of our time. The Lowell Company, however, persevered, and ingrain factories continued to spring up in various parts of the country. The progress was slow, and with the exception of the Hartford Carpet Company, then operating as two separate concerns, very few of the firms which afterward became famous started until many years later.

E. S. Higgins & Company began to manufacture ingrains in New York in 1841. Alexander Smith began at West Farms in 1844. Robert Beattie started in New York in 1840. John Bromley did not set up his looms in Philadelphia until 1845. This city now has some of the finest factories in existence, and its production is larger than that of all the rest of the country combined. More yards of ingrain carpets are made there than in any other city in the world, and the goods range from the highest to the lowest grade. The imports from England and Scotland continued to be heavy in spite of distance and duties, as up to 1850 hand-looms only being in use, the product of these and the other mills using these looms was necessarily very limited, and we had to overcome the prejudice against domestic goods.

Meanwhile Alexander Smith and J. G. McNair had devoted much time and labor to the invention of a patent process for weaving tapestry ingrains. They succeeded in producing a carpet which filled a want of the times for a strong and durable fabric in which a large variety of color could be introduced. The Crossleys, of Halifax, England, purchased the rights to the invention, paying a royalty of a penny a yard for England. Templeton, of Ayr, paid £200 and a like royalty for Scotland. The goods became enormously popular, and Stephen Sanford, of Amsterdam, N. Y., also secured the right to manufacture them. The fame of the carpets spread so rapidly that it did much to stop the importation of foreign ingrains.

Erastus B. Bigelow, a young medical student of Boston, who was but twenty years of age, had seen somewhere the manufacture of coach-lace by hand. He was without mechanical training, and, in fact, had never read a book on the subject; but in forty days after he took up the idea he perfected a power-loom by which coach-lace weaving could be done. At a single stroke he so reduced the cost of weaving this class of goods that what had previously cost twenty-two cents a yard was reduced to three cents. This invention brought him into notice, and he set to work to devise a power-loom for ingrain-carpet weaving. Before the year was out he succeeded. At this time eight yards a day was the product of the ingrain hand-loom. Mr. Bigelow's loom at once increased the product to ten and twelve yards, and, after some defects had been remedied, rolled it up to twenty-five yards a day, thus stimulating successive inventors of power-looms, such as Duckworth, Murkland, Crompton, and others, who have multiplied the result, so that the product now reaches to from forty to forty-five yards a day, although the hours of labor have been materially shortened.

But Mr. Bigelow did not rest here. In 1848 he set to work to invent a power-loom for the weaving of Brussels and tapestry carpets. At this time the product of a long and hard day's labor for a weaver, including a boy to draw the wires, was seven yards of Brussels carpet. At once Mr. Bigelow raised this to over twenty-five, some modern machines now getting fifty-five yards of production in a day. Prior to the perfecting of this invention, he had, with his

brother, Horatio N., organized the Bigelow Carpet Company, which has the honor of being the original power-loom manufacturer of Brussels and Wilton carpets. The company has been very successful, and now ranks among the foremost concerns in the world. The Crossleys, of England, promptly purchased, at a cost of £20,000, the right to use the Bigelow loom in England; and A. & E. S. Higgins, of New York, and the Roxbury Carpet Company, of Massachusetts, also secured the exclusive use for the United States for tapestry and velvet during the term of the patent. Mr. Bigelow, of course, reserved the right to manufacture Wiltons and Brussels on his own loom. It has been my experience, in a connection of over thirty years with the trade, that the Wiltons, velvets, Brussels, and tapestries made at that day by these establishments would compare favorably in durability of wear and stability of color with the same grades of any country in the world.

The success of Mr. Bigelow's looms stimulated others to like inventions. The manufacture of Axminster and moquette carpets by hand in foreign countries was one of the slowest of trade processes. In this two men and a boy were employed at one loom, and could make but one and one half yards of French moquette in a day. In 1860, Alexander Smith and Halcyon Skinner, of Yonkers, invented an Axminster and moquette power-loom which was perhaps more striking in its ability to increase the productive capacity of labor than was that of Mr. Bigelow.

This was the beginning of a second era in the trade. The invention increased the production to about eleven yards per day, the loom being attended by a girl. Its merits were universally conceded, and foreign and domestic manufacturers were glad to pay large royalties for its use. The Alexander Smith & Sons Carpet Company became one of the most famous in the world, and its plant in Yonkers is to-day the largest of the kind in the country. How thoroughly American invention and American mechanical skill have gained control of the home market can easily be understood from a few figures, which I present as follows:

In the year ending June 30, 1870, there were entered at the port of New York alone body Brussels and tapestry Brussels valued at $1,355,832; in 1894 there were imported in the entire United States body Brussels and tapestry Brussels valued at $58,-208. In 1870 the manufacture of carpets in the United States amounted in value to $21,761,573; in 1890 the value of the carpets made in the United States was $47,770,193.

The number of firms engaged in the various departments, with the approximate number of power-looms employed, was last year as follows:

PRODUCTION OF CARPETS.

Varieties.	Manufacturers.	Power-Looms.
Ingrains	89	4,800
Brussels and Wilton	16	1,200
Tapestry and velvet	14	1,700
Axminster and moquette	6	600

These firms were capable of producing 100,000,-000 yards, of the value of $50,000,000. There are also many hand-looms on ingrains, and many manufacturers of damasks and Venetians, Smyrna and other rugs and mats.

On the artistic side the improvement has been equally great. At the outset most of our designs were copied or adapted from foreign patterns. It was only a few years ago that a foreign manufacturer, to whom I showed a sample of the first piece of tapestry produced by Stephen Sanford, remarked, after examining the fabric closely, "Well, you may be able to manufacture the goods, but you can't design them." In less than five years from that time, the same gentleman, on his way to Canada to sell goods, proposed to me to exchange samples, that he might take orders from the American patterns. After looking through his line I thanked him, with the assurance that I could find nothing there that could compare favorably with the discarded designs of last season's patterns of our domestic manufacture. In the fully equipped studios of the Bigelow, Lowell, Smith, Hartford, Higgins, and the Philadelphia companies a large proportion of the designers are Americans, and the proportion is steadily increasing. The American dealer of to-day has to overcome very little prejudice against either the fabric, color, or pattern of American carpets, and it is long since I have heard a customer ask, "Is it English?"

Were I able to give the exact amount of money expended each year, from the time the wool leaves the sheep's back until the carpet reaches its resting-place upon the floor of our homes, to be trodden upon, beaten, and sometimes abused, notwithstanding the fact that there is no article which goes so far to make the home comfortable and attractive, the figures would be astonishing. The people employed in designing, manufacturing, and selling this article to-day would form a sufficient population for a young republic, with abundant capital to carry on the government.

The skill and inventive genius in carpet manufac-

tories have so built up the home industry of the United States as to give employment to a vast army of operatives, and reduced the cost of the manufactured article to such an extent that the humblest citizen is enabled to have a floor well carpeted with fabrics that are attractive, and even artistic; and, with the thrifty housewife, the addition of a rug or two upon the carpet and a good lining underneath is necessary, in her estimation, to sustain her status as one of the social leaders in her humble sphere.

In no other time and no other country has such comparative luxury been within the reach of modest means. The white and well-scrubbed floor of the Holland frau, the polished oak and tiling of France, Germany, Italy, Austria, and the other countries of continental Europe, have given no precedent for the American indulgence in carpets; and even England, outgrowing the rush and straw strewn floors of the time of Erasmus, has not yet learned to fill the great gap between the velvet pile carpets of the homes of the nobility and the bare boards of the Whitechapel tenements. It is in this respect that the United States stands forth preëminent. There are carpets for all, and from the days when the grandmothers wove their rag carpets, to the present, when a far superior article is turned out from nearly every factory in the country, at a cost cheaper even than that of the home-made article, there have been few American homes too poor to enjoy the comfort of neat and pretty floor coverings.

Sheppard Knapp

CHAPTER LXXIV

THE CORDAGE INDUSTRY

THE infancy of this industry was marked by great feebleness, but perhaps not more so than the average of American manufactures. Rope making formed one of the principal branches of business from the early days of the colonies, and a ropewalk appears to have been first set up in 1642, in Boston, Mass., twelve years after the town was founded. In this connection it is interesting to note that in 1638 Boston was "rather a village than a town, consisting of no more than twenty or thirty houses." Prior to that time nearly every kind of rigging and tackle for vessels was brought from England.

With the building of the first ship in Boston, the *Trial*, of 160 tons, and probably on account of its construction, John Harrison, a rope maker, was invited to Boston from Salisbury, "on mocon of some gentlemen of this town," and he set up his ropewalk or "rope-field," ten feet ten inches wide, on the land adjoining his house on Purchase Street, at the foot of Summer Street. The work was done in the open field. Posts were set in the ground firmly enough to permit the suspension of cords and rope of no inconsiderable circumference.

Harrison was granted a monopoly of the business until 1663, when permission was granted to John Heyman to "set up his posts," but with "libertie onely to make fishing lines"; but even this license was found so to interfere with Harrison—who was now advanced in years and had a family of eleven persons—that it caused him to fear that he could not support them, and Heyman's permit was accordingly withdrawn. An additional argument employed to bring about this revocation was the scarcity of hemp! After Harrison's death ropewalks multiplied in number, and at the West and North Ends of the town in sixty years there were fourteen ropewalks. In 1793 the industry was thriving, no doubt greatly fostered by a bounty granted by the General Court.

In a great fire, July 30, 1794, seven ropewalks were destroyed; and the selectmen provided that no more should be constructed in the heart of the town, and tendered the use of the low land west of the Common, where six others were at once constructed, 20 to 24 feet wide and 900 feet in length. These were also destroyed by fire in 1806. Five were rebuilt, and were all once more burned in 1819. The elder Quincy, in the first year of his mayoralty, with his usual energy and sagacity, promptly removed all of these, with marked improvement to the neighborhood, and the land was purchased for $55,000 on February 25, 1824.

So much for the early beginnings of this industry. It is with a smile that we read that "in the Federal procession of 1788 the men employed in this industry outnumbered any other class of mechanics in Boston," and that in 1794 "over fifty men were employed in this branch alone." The work in the old ropewalks, although done mostly by hand, was in some cases supplemented by horse or water power. The workmen resented the employment of any hands who had not served a regular apprenticeship at the trade, and there was bitter opposition to the introduction of machinery.

Besides the ropewalks previously mentioned, Nantucket had, in the height of her prosperity, three, none of which now exists. Newburyport had a good-sized ropewalk for those days. There was one at Castine, Me. One was on Broadway, New York, before the Revolution, and others were found in other parts of the country. Early in the century Samuel Pearson owned and operated one in Portland, Me. His two sons, Samuel and George C. Pearson, having learned the trade with their father, were afterward interested in steam plants at and near Boston. Still later they started the Suffolk Cordage Company, which grew into the Pearson Cordage Company, now one of the largest mills in the country.

Shortly after the death of his father (Samuel), Mr. Charles H. Pearson, who had been identified with him and the other son, became connected with the Boston Cordage Company, and still later with the Standard Cordage Company. Mr. Samuel Pearson made many inventions in rope-machines and in regulators for spinning.

Mr. A. L. Tubbs, of California, bought most of the machinery in one of the old Boston mills and shipped it to California. He started the business on the Pacific coast, and at the present day controls the two or three factories now located there.

Up to about 1850 it was the custom to import spun yarns to be made into cordage. These yarns were chiefly spun by Russian serfs, and could be furnished for less money than similar ones made here; but the introduction of improved machinery gradually cut off these importations, and hardly any spun yarns were bought after 1865.

The period between 1830 and 1850 witnessed the starting of what may be termed the modern factory, in distinction from the crude and primitive mode of manufacture before existing. The difference between the two methods was this: In the old-fashioned ropewalk the twisting of fibers was done by a man walking backward down the walk, spinning from the hemp round his waist, the twist being imparted from a wheel turned by a boy. The possible length of the rope could thus be no greater than the length of the building or ground. Longfellow's description, in his poem on "The Ropewalk," is too fine to be omitted, even in a commercial article:

> "In that building, long and low,
> With its windows all arow,
> Like the port-holes of a hulk,
> Human spiders spin and spin,
> Backward down their threads so thin
> Dropping, each a hempen bulk.
>
> "At the end, an open door;
> Squares of sunshine on the floor
> Light the long and dusky lane;
> And the whirring of a wheel,
> Dull and drowsy, makes me feel
> All its spokes are in my brain."

In the modern factory the twist is imparted by rapidly rotating machinery similar to that used in cotton and woolen mills, making it possible to spin a rope of several thousand feet in length on an upright apparatus occupying but a few square feet. For some purposes, however, the ropewalk rope, as it is called, is still held to be superior to that manufactured by the other process. When rope was made without use of the ropewalk it was the custom to call it "patent cordage," to distinguish it from the old style of ropewalk rope, and the name is still used by some firms.

The inventions and patents of most consequence and in most general use are those of John Good, of New York City, whose spreaders and breakers did away with the use of lappers, and whose nipper and regulator on spinning-machines have given universal satisfaction, although with the perfecting of "preparation machinery" the use of a regulator has in many instances been discontinued.

The era of the largest mills commenced in 1878, after the invention of the self-binding harvester. Among the factories started during the period alluded to were Sewall, Day & Company of Boston (1835); Pearson Cordage Company of Boston; J. Nickerson & Company of Boston; Weaver, Fitler & Company of Philadelphia (afterward and at the present day Edwin H. Fitler & Company); Plymouth Cordage Company of Plymouth, Mass.; Hingham Cordage Company of Hingham, Mass.; New Bedford Cordage Company of New Bedford, Mass. (1842); Baumgardner, Woodward & Company of Philadelphia; J. T. Donnell & Company of Bath, Me.; William Wall & Sons of New York City; Lawrence Waterbury & Company of New York; Tucker, Carter & Company of New York; Elizabethport Steam Cordage Company of New York; Thomas Jackson & Son of Easton, Pa.; J. Rinek's Sons of Easton, Pa.; and John Bonte's Sons of Cincinnati.

The demand for cordage in those days being largely for export and the use of ships, it will be noticed that the manufacture was mainly confined to Atlantic seaports. In later times, with the decline of American shipping, the substitution of wire for hemp standing rigging, and especially after the great demand for binder twine, all this was changed, and factories rapidly multiplied in the West, Peoria, Miamisburg, Akron, and Xenia taking an important part in the business.

As late as the year 1843 the total quantity of Manila hemp manufactured in the United States was only 27,820 bales or 7,511,400 pounds. This amount of hemp could, in 1895, easily be brought from Manila in three sailing-ships or in two steamers—the latter capable of making the voyage in fifty or sixty days by the way of the Suez Canal to New York, Boston, or Philadelphia. Moreover, one of half a dozen of the larger mills in the country could, in 1895, manufacture the whole quantity of Manila hemp used in the year 1843 in the space of fifty days, by running night and day.

In 1863 the business had increased to five times its size in 1843. With the War of the Rebellion came a great demand for cordage; and as hemps rapidly advanced in price, in common with all other staples, it was an era of great prosperity for the cordage industry. Orders were so numerous that it was deemed a favor to a customer to supply him; and it is within the knowledge of the writer that the profits of one Eastern factory during that epoch amounted in one year to $520,000, nor was its experience at all exceptional.

It was in 1860 that the first importations of Sisal hemp were made. Commencing with the manufacture of about 200 tons in that year, its use rapidly extended, and it became in a few years an important factor in the trade. In ten years its importation amounted to 3500 tons, in twenty years to 13,000 tons, in thirty years to 34,000 tons, and in thirty-five years to 50,000 tons.

With the extension of the business and the increase of factories, both in number and importance, there was found to be a necessity for some regulation of the prices of cordage. The first agreement between the cordage manufacturers was entered into on February 23, 1861, the object being to correct certain abuses which had prevailed among firms engaged in the trade. Weekly meetings were held by the manufacturers in their respective cities, and opportunity afforded for any complaints or any suggestion about the condition of trade and the regulation of prices. The object, as stated by one of the Eastern manufacturers, was "to look each other in the face and maintain prices." Various amendments were from time to time made in this agreement of 1861, but in July, 1874, a careful revision was made and the manufacturers pledged themselves, "as men of honor and integrity," to the true and faithful observance of the rules. A stronger agreement was made in April, 1875; but complaints of underselling, answered with various excuses, were frequent, and, there being no pecuniary penalty, the ingenuity of the manufacturers finally hit upon what was known as the "pool system." This went into operation on January 1, 1878. The business was divided among the manufacturers in proportions which seemed just, and when the business of one concern exceeded during any month the proportion which its share bore to the total business done according to the returns, it would pay in so much per pound on the excess. In case a concern fell short it would be a recipient to that extent.

It was supposed that this arrangement would act as a preventive to the cutting of prices, and it undoubtedly had that effect to some extent. The novelty of the plan was also in its favor, and on the whole it worked well enough amply to repay the great amount of labor expended in securing its adoption. The percentages ranged from eleven and one fourth to one per cent.

In 1880 the amount of the pool was reduced from two cents to one cent per pound, and in June of that year to one-fourth cent; in January, 1881, the pool was abolished. In April, 1882, it was deemed best to reëstablish it, and on the 28th of June the proportions were again agreed upon for three years. At the expiration of that time the new concerns which had grown up were taken into the association, and after much labor, lasting from February to July, 1885, a new pool was formed, and the proportions as fixed by the committee were accepted.

No one who was present will ever forget the magnificent banquet given at Long Branch, on the 29th of July, 1885, to the members of the association, by the Hon. Edwin H. Fitler, of Philadelphia, who, as president for many years, had been untiring in his efforts to unite the members and preserve harmony. Equal honor should be awarded to Mr. Frederick Davis, of Sewall, Day & Company of Boston, and to Mr. D. B. Whitlock of New York, for many years secretary of the association, who died in 1888.

In April, 1887, before the expiration of the time agreed upon at the formation of the last pool, it was broken up; and the next event of great interest was the formation and incorporation of the National Cordage Company. This was composed of the four leading concerns in New York City; and although their circular, dated August 1, 1887, announced that their "large facilities and long-established reputation were a guaranty that they could fulfil all that they promised to do," yet the successful accomplishment of their aims would have demonstrated that the age of miracles was not wholly past. The projectors were, no doubt, sanguine enough really to believe that it was possible to control the product and prices of Manila and Sisal hemp, but the attempt was a failure. An effort was made to subsidize the houses and brokers engaged in the trade, but they did not remain subsidized, and the scheme would not work. In some remarks made by the writer, May 27, 1886, in the Old South Church, Boston, at a meeting called to discuss the Morrison tariff bill, he said: "The day of monopolies in this country is past, and there is no danger but that the competition among ourselves, with the wonderful and ever-increasing labor-saving appliances and economical devices of

the present day, will keep down prices, in our own products at least, to a reasonable point."

Thus it was with the attempt alluded to. The time had gone by for any such arrangement to be more than temporary, and measures to undermine the project were taken by those who did not propose to give up their individual judgment in purchasing raw material; and it is not strange that, with the immutable laws of trade working in their favor, these measures were at once and continuously successful. The National Cordage Company was in the position of a whale attacked by swordfish. The whale was only one organization, and was cumbersome and unwieldy; the swordfish were numerous and extremely lively in their movements, and the result of the conflict was what might reasonably have been expected. The whale was exhausted by his attempts to maintain his ground, and what was bad rapidly became worse. In January, 1890, the National Cordage Company made an attempt to have all the manufacturers outside of their organization join them. But no one who joined the National knew the terms made with his neighbor, and it was not long before distrust and suspicion ruined the whole project. On the 4th of May, 1893, the National passed into the hands of receivers, although they had paid eight per cent. dividends from 1891 on their preferred, and from nine to ten and one half per cent. on their common stock, dividends having been declared on both three days before their failure.

It is too early to write the history of the United States Cordage Company, which organization succeeded the National Cordage Company. Circumstances scarcely controllable by any one resulted in disaster, and, in fact, its career was never much more than a continued liquidation. A fall in the prices of raw material, unexpected and unprecedented, together with other misfortunes, culminated in the appointment of receivers, June 3, 1895.

For the future the prospect is brighter, and with lower fixed charges, strict economy, judicious purchases of the raw material as needed, a substantial cash capital, and especially with the stock of binder twine in the country practically used up for the first time in five years, we may hope that the interest on the bonds may be easily earned and the industry again give fair results.

The figures given below are the aggregate of the sworn returns of rope delivered by the members of the United States Cordage Manufacturers' Association.

MANUFACTURED IN 1878, 1879, AND 1880, IN POUNDS.

Year.	Manila.		Total.	Sisal.	Total.	Grand Total.
1878........	Home Trade	26,483,833		14,085,037		
	Export	4,213,964	30,697,797	1,878,825	15,963,862	46,661,659
1879........	Home Trade	33,839,404		19,672,800		
	Export	4,360,127	38,199,531	1,936,093	21,608,893	59,808,424
1880........	Home Trade	40,729,619		23,945,019		
	Export	3,840,748	44,570,367	1,965,075	25,910,094	70,480,461

MANUFACTURED SINCE 1880.

Year.	Manila.		Sisal.		Grand Total.
	Bales.	Pounds.	Bales.	Pounds.	Pounds.
1881	216,706	58,510,620	100,777	38,803,060	97,313,680
1882	193,873	52,345,710	102,067	40,826,800	93,172,510
1883	184,489	49,812,030	115,239	46,095,600	95,907,630
1884	202,208	54,596,160	161,800	64,720,000	119,316,160
1885	190,960	51,550,200	178,650	69,673,500	121,232,700
1886	177,221	47,849,670	204,008	78,013.230	125,862,900
1887	260,000	70,200,000	205,000	76,875,000	147,075,000
1888	340,000	91,800,000	190,000	71,250,000	163,050,000
1889	320,000	86,400,000	220,000	83,600,000	170,000,000
1890	260,000	70,200,000	190,000	68,400,000	158,600,000
1891	330,000	89,100,000	240,000	86,400,000	195,500,000
1892	332,000	89,640,000	342,000	123,120,000	233,160,000
1893	350,388	94,604,760	310,369	114,836,530	231,441,290
1894	334,377	90,281,790	308,193	110,949,480	211,231,270

Benjamin C. Clark.

Canada is included in the years 1892, 1893, and 1894, but not before, on manila. In 1890 and 1891 New Zealand added 20,000,000 pounds to the consumption for each year; 1892, 20,400,000 pounds; 1893, 22,000,000 pounds; and 1894, 10,000,000 pounds.

There are about 10,000 spindles in this industry at the present time, two thirds of which are ample to supply the wants of the country. The annual product amounts to $12,000,000. The figures given below were collected with much care, and will give an approximate idea of the growth of this industry. Other fibers, such as Russian and Italian hemps and jute, have at times been used to a considerable extent, but the writer believes that the figures he has collected practically give what is needed for statistical purposes.

Early figures of this trade are as below:

TABLE OF QUANTITIES OF MANILA, SISAL HEMP, ETC., MANUFACTURED IN THE UNITED STATES, 1843 TO 1877.

Year.	Manila.		Sisal.			Total Pounds.
	Bales of 270 Lbs.	Pounds.	Bales.	Size of Bales in Pounds.	Pounds.	
1843	27,820	7,511,400	......	...	....	7,511,400
1844	48,830	13,184,100	......	...	....	13,184,100
1845	47,438	12,808,260	......	...	....	12,808,260
1846	46,343	12,512,610	......	...	....	12,512,610
1847	39,111	10,559,970	......	...	....	10,559,970
1848	62,120	16,772,400	......	...	....	16,772,400
1849	48,726	13,156,020	......	...	....	13,156,020
1850	72,769	19,647,630	......	...	....	19,647,630
1851	60,888	16,439,760	......	...	....	16,439,760
1852	87,166	23,534,820	......	...	....	23,534,820
1853	106,376	28,721,520	......	...	....	28,721,520
1854	90,174	24,346,980	......	...	....	24,346,980
1855	100,760	27,205,200	......	...	....	27,205,200
1856	114,203	30,834,810	......	...	....	30,834,810
1857	119,156	32,172,120	......	...	....	32,172,120
1858	110,682	29,884,140	.....	...	....	29,884,140
1859	129,321	34,916,670	......	...	....	34,916,670
1860	143,618	38,776,860	1,393	320	445,760	39,222,620
1861	105,322	28,436,940	627	...	200,640	28,637,580
1862	120,878	32,637,060	1,356	...	433,920	33,070,980
1863	132,358	35,736,660	1,995	325	648,375	36,385,035
1864	135,304	36,532,080	2,774	330	915,420	37,447,500
1865	128,508	34,697,160	2,797	335	936,995	35,634,155
1866	140,330	37,889,100	5,120	334	1,710,080	39,599,180
1867	134,253	36,248,310	6,871	340	2,336,140	38,584,450
1868	141,962	38,329,740	9,406	340	3,198,040	41,527,780
1869	136,483	36,850,410	16,646	350	5,826,100	42,676,510
1870	133,338	36,001,260	19,893	...	6,962,550	42,963,810
1871	157,342	42,482,340	16,733	352	5,890,016	48,372,356
1872	155,173	41,896,710	22,479	359	8,069,961	49,966,671
1873	150,629	40,669,830	22,402	360	8,064,720	48,734,550
1874	137,608	37,154,160	30,527	350	10,684,450	47,838,610
1875	125,904	33,994,080	31,313	402	12,587,826	46,581,906
1876	132,231	35,702,370	41,864	389	16,285,096	51,987,466
1877	146,715	39,613,050	51,538	404	20,821,352	60,434,402
	3,769,839	1,017,856,530	285,734	...	106,017,441	1,123,873,971

Benj. C. Clark

CHAPTER LXXV

HIDES AND LEATHER

THERE is probably no industry in which the advance in scientific attainments and business methods during the last one hundred years has been greater, or has wrought more important changes, than in the manufacture of leather; and there is likewise no product except those of agriculture, the application of which to the uses of mankind is of greater antiquity. From the earliest period known to history the skins of animals, however crudely prepared, have contributed to the necessities and comforts of man, and, at the present day, there is no product which contributes more luxury to enlightened humanity than "hides and leather." Dr. Campbell, in his "Political Survey of Great Britain," aptly says: "If we look abroad on the instruments of husbandry, or the implements used in most mechanic trades, or the structure of a multitude of engines and machines; or if we contemplate at home the necessary parts of our clothing,—breeches, shoes, boots, gloves,—or the furniture of our houses, the books on our shelves, the harness on our horses, and even the substance of our carriages, what do we see but instances of human industry exerted upon leather? What an aptitude has this single material in a variety of circumstances for the relief of our necessities, and supplying conveniences in every state and stage of life! Without it, or even without it in the plenty we have it, to what difficulties should we be exposed!"

The art of tanning is one of very great antiquity, and it is difficult to resist the temptation to refer, however briefly, to the fact that the ancient Egyptians inscribed on their tombs tableaux which referred to the tanner; that the Jews, after the exodus, practised the knowledge learned of the subjects of the Pharaohs in preparing the rams' skins for the service of the tabernacle; that in the sepulchers of ancient Mexico there have been found bronze leather slices similar to the Egyptian, indicating a knowledge of leather working by a people possibly coeval with those of the Eastern continent. For hundreds of years there appears to have been no marked improvement in the tanning of leather, although there are evidences of attempts to beautify it, for there are specimens of embossed leathers made by the Moors centuries ago. There is no accurate way of ascertaining the nature of the preparation by the ancients, but they subjected the skins to some treatment to prevent putrefaction. There is probably no vegetable growth containing tannin which has not been tried and found favor; but of all these oak-bark has held undisputed sway as the best tanning agent for many years.

It is only within the last sixty or seventy years that the manufacture of leather has taken great strides, and, like many other industries, its advance was made by the energy, inventive genius, and business ability of the American people. Originally the small tanners depended for hides upon the surrounding country. With the advent of the canal, and later the railroad and steamship, together with the application of chemical science, the tanner of to-day is dependent upon no one country or any special animal for his raw material, for the birds of the air and the creatures of the ocean assist in contributing to his needs in the present age. Hides, as the term is accepted to-day, can be divided into three classes: (1) hides proper, comprising the skins of the larger animals, such as those of oxen, cows, and horses; (2) kips, or the skins of small or yearling cattle, exceeding the size of calfskins; (3) skins, including those of calves, sheep, goats, deer, pigs, seals, and various kinds of fur-bearing animals, which latter, of course, usually retain their hair after tanning.

The heavy hides are converted into sole, belt, and harness leather. Calfskin is a principal material for the manufacture of upper leather for shoes and boots, and is much used for bookbinding. Sheepskins are used for a variety of purposes, such as lin-

ings for shoes, bellows, whips, aprons, cushions and covers, gloves, women's shoes, etc. Goatskins are used almost exclusively for gloves and ladies' shoes. The morocco leather, so extensively made until recently, has almost entirely given way to the "glazed kid" of the present day. Hogskins are useful for saddle-leather, traveling-bags, etc. Dog-skins, being thin and tough, are valuable for gloves. Porpoise-skin, on account of its durability, is used for shoe-strings. It may be interesting to note that among the other creatures who contribute their skins to the tanner are found the buffalo, kangaroo, alligator, deer, hippopotamus, elephant, rhinoceros, walrus, and even the shark.

From the best records obtainable, it appears that the first tannery in this country was operated about the year 1630, in Virginia; and a year or two later the first tannery in New England was established in the village of Swampscott, in Lynn, Mass., by Francis Ingalls, who came from Lincolnshire, England. The vats used by him were filled up in 1825. The industry was much encouraged by the colonial authorities, and there are many records of laws made regulating the manufacture of leather and the saving of skins for the tanners, under heavy fines for non-compliance. In 1646 a law was made in Massachusetts prohibiting the exportation of raw hides or unwrought leather, under heavy penalty alike to the shipper and the master of the vessel. It is a fact, and probably a consequence of these laws, that in a little more than twenty years, or about 1651, leather was relatively more plentiful here than in England.

A noted leather manufacturer, who left a considerable impress upon the business in the beginning of the period covered by this work, was Colonel William Edwards. He commenced business in Hampshire in 1790, before he was twenty years of age, and sent the first tanned leather from there to the Boston market in 1794. He began a series of improvements in the mechanical branch of the art, which were adopted and extended by others, and infused a greater spirit of enterprise into the business. His new ideas in mechanism and in the arrangement of the tannery were among the earliest and most important of the advances in leather manufacture. Probably the first incorporated company in the business was the Hampshire Leather-Manufacturing Company, of Massachusetts, established in 1809, with a capital of $100,000, chiefly owned by merchants of Boston, who purchased the extensive tanneries of Colonel Edwards and his associates at Northampton, Cunnington, and Chester. These works had a capacity of 16,000 full-grown hides a year.

In 1810 tanneries were established everywhere, the bark being cheaper by far than in England; and 350,000 pounds of American leather were annually exported, although some particular kinds of English leather and morocco were imported. The value of all the manufactures of hides and skins at this time, according to the census of 1810, was $17,935,477. The actual amount was probably over $20,000,000, as this census was very crude and incomplete. Only the manufactures of the loom, including wool, flax, hemp, and silk, exceeded in importance and amount at this time those of hides and skins. The business increased gradually and steadily until, in 1840, there were about 8000 tanneries in the United States, with a capital of $16,000,000, and employing about 26,000 hands. In 1850 the capital employed was over $20,000,000, and the value of the product of hides and skins alone was $38,000,000, which in 1860 had increased, including morocco and patent leather, to $72,000,000. In 1870 there were 7569 establishments, employing 35,243 hands, whose wages amounted to $14,505,775; the capital engaged was $61,124,812, and the product was valued at $157,237,597.

The number of establishments making leather was enumerated so differently by the census of 1890 and that of 1880 that the statistics do not furnish a reliable basis of comparison. In the census of 1880 the enumerators evidently included all the small tanners and curriers, making an aggregate of 5424 establishments. In 1890 they as certainly included only the large establishments, for they report 1596. The figures of 1880 are the more nearly correct.

THE LEATHER INDUSTRY, 1880 TO 1890.

	1880.	1890.
Capital	$67,100,574	$81,261,696
Number of employees	34,865	34,348
Wages paid	$14,049,656	$17,825,605
Cost of material used	145,255,716	100,114,806
Value of product	184,699,633	138,282,004

The very great difference between the two years in the cost of material used and the value of product is attributable to the remarkable decline in prices, which were at a maximum in 1880 and at a minimum in 1890.

It will be observed that the number of persons employed was a little larger in 1880 than in 1890. The explanation of this is found in the introduction

of machinery, making fewer hands necessary to perform the same service. Long after all other important industries had been revolutionized by the introduction of machinery, tanning and leather manufacturing continued to be done by manual labor. Inventions in this line were generally frowned upon. Formulæ and processes had been transmitted from father to son for generations, and it was considered impossible to make leather in any other way. While these barriers have been gradually removed, and inventive genius appreciated, yet it is only within the last ten or fifteen years that the most radical changes are recorded and the old traditions done away with.

Among the first patents taken out for the application of a special process in the manufacture of leather was one, in 1823, by which the tanning liquor was forced through the skin by hydrostatic pressure. A modification of this was introduced by William Drake, in 1831, by which two skins were sewed together, the liquor being put in the vessel thus formed, and allowed to remain until the tanning was completed. In 1826 a patent was issued for suspending the hides in a close vessel, from which the air was removed by an air-pump, and the conversion of hides into leather much accelerated. To enumerate the patents would require too much space; but I give below the dates when the first patent was issued for each of the details which enter into leather manufacture, and also the number of patents in each item up to the present time. The total is approximated, as I have not at hand the records of the last several years.

LEATHER PATENTS.

Purpose for which Issued.	Date of First Patent.	Approximate Total Number of Patents to Date.
Processes and apparatus for leaching and making extracts from tan-bark	Aug. 10, 1791	100
Bark-mills	July 19, 1794	100
Processes employing apparatus for tanning leather	July 9, 1808	100
Leather-splitting machine	July 9, 1808	75
Unhairing-machine	July 12, 1812	75
For rolling leather	Oct. 19, 1812	25
Scouring and setting machine	Nov. 21, 1831	70
Tanners' vats and handling appliances	Jan. 9, 1834	75
Machines for boarding and graining leather	March 25, 1835	35
Compounds for depilating hides and skins	June 30, 1836	60
For fleshing-machines	June 17, 1837	25
Compounds for bating hides and skins	Feb. 3, 1838	40
Whitening, buffing, and shaving leather	May 10, 1838	30
Compounds and materials for tanning and tawing leather and preparing raw hides	July 12, 1838	175
Processes for tanning leather	Aug. 1, 1838	275
For currying leather	Aug. 1, 1838	25
Machines for stoning, polishing, finishing, glassing, glazing, flinting, creasing, and dicing leather	March 15, 1845	75
Compounds for coloring and polishing leather	Oct. 9, 1847	40
Methods for manufacturing enameled, japanned, and patent leather	Jan. 9, 1855	20
For stuffing leather	Feb. 6, 1855	20
For pebbling leather	May 6, 1856	30
For employing mineral substances for tawing hides and skins	Aug. 4, 1857	20
For stretching leather	Feb. 8, 1859	40
Bark-rossing machines	Jan. 9, 1863	10
For preserving hides	Sept. 11, 1866	15
Machines for shaving or making leather of uniform thickness	Sept. 24, 1867	5
Apparatus for blacking leather	Sept. 20, 1870	15
Measuring-machines	Aug. 28, 1877	25
Striking-out machines	March 27, 1883	4

The number of cattle killed in the United States whose hides furnished raw material for the tanner is not recorded prior to 1868; but since that time the Department of Agriculture has a cattle census taken each year. As the number killed is about one fourth of the total, the following figures are approximated. The number of cattle (cows and steers) killed in the United States in 1868 was 5,100,000; 1870, 6,400,000; 1875, 6,800,000; 1880, 8,300,000; 1885, 11,000,000; 1890, 13,200,000; 1894, 13,250,000.

The imports of all kinds of hides and skins into the United States from 1821 to the present time (year ending June 30th from 1850 to date; prior to 1850, September 30th) were valued as follows:

IMPORTS OF HIDES AND SKINS.

Year.	Goatskins.	All Others.	Total.
1821	Not classified	Not classified	$892,530
1830	"	"	2,409,850
1840	"	"	2,756,214
1850	"	"	4,799,031
1860	"	"	10,524,706
1870	"	"	13,003,560
1880	"	"	30,002,254
1883	"	"	27,640,030
1885	$4,197,376	$16,388,904	20,586,280
1890	9,106,082	12,775,804	21,881,886
1893	12,844,245	15,503,647	28,347,892
1894	8,583,211	8,202,941	16,786,152
1895	10,954,827	15,168,115	26,122,942

Robert H. Foerderer.

No hides were imported and none were wanted until about 1815; the largest tannery in the United States at that time turned out 10,000 hides a year.

The imports and exports of tanned leather in the last twelve years are shown to better advantage by being placed side by side, and no better illustration can be given of the superiority of the American article, and the progressiveness and persistence of the American manufacturer:

EXPORTS AND IMPORTS OF LEATHER.

Year ending June 30.	Imported.	Exported.
1884	$7,258,799	$6,792,574
1888	6,829,722	7,952,169
1892	6,689,506	9,913,369
1895	6,606,838	12,958,312

An interesting phase in the history of any industry for the past one hundred years is developed in the consideration of the duties levied from time to time, and the changes made by the government during that period. In the leather industry this subject is embraced in the following:

TARIFF RATES ON LEATHER, 1789 TO 1894.

Year.	Raw Hides and Skins.	Leather (All Kinds).	Sole Leather.	Upper Leather.	Calfskins.	Patent Leather.
1789	Free	7½%	....	......	...	....
1792	"	10 %	....	......	...	....
1795	"	15 %	....	......	....	....
1804	"	17½%	....	......	....	...
1812	"	35 %	....	......	....	....
1816	"	30 %	....	......	....	....
1836	"	28 %	...	......	....	....
1841	"	26 %	.. .	......	....	....
1842	5%	......	23%	8c. per lb.	....	....
1846	5%	......	20%	8c. "	20%	....
1857	4%	......	15%	8c. "	15%	...
1861 (March)	5%	......	20%	8c. "	25%	30%
1861 (December)	10%	......	20%	8c. "	25%	30%
1863	10%	......	35%	8c. "	30%	35%
1866	10%	......	35%	8c. "	30%	35%
1873	Free	......	15%	25%	25%	35%
1883	"	......	15%	20%	25%	35%
1890	"	......	10%	20%	20%	20%
1894	"	......	10%	20%	20%	20%

In the gathering of statistical information for this article I am much indebted to Mr. F. W. Norcross, of the "Shoe and Leather Reporter" of New York.

The various tannages are oak-bark, hemlock-bark, union, Dongola, alum, chrome, combination, electric, sumac, and gambier, in addition to which there have been experiments without number. In the tannage process of sole-leather almost the only change which has taken place is a slight diminution of the time required. This has been accomplished wholly by mechanical improvements. Experiments are constantly being made, however, and it is believed the day is not far distant when sole-leather will be turned out in as many days—perhaps hours—as it now takes weeks. In the lighter skins the change has already been radical. About 1880 Dongola kid was first put on the market, being the result of a discovery by James Kent, of Gloversville, N. Y., which completely revolutionized the manufacture of kid or morocco. As far back as 1856 the system of tanning or tawing by the use of chromium compounds was discovered by a German chemist; but all the early experiments failed because the tannage could not be made permanent. A remedy was finally found in hyposulphite of sodium, by which the tannage was made lasting. The discovery of the remedy and its successful application were made in Philadelphia, and were the means of creating in that city within five years what is to-day the largest and best equipped leather manufactory in the world.

The future of the great leather industry is dependent entirely upon skill and a knowledge of chemical and scientific principles. Upon these depend the acceleration and cheapening of the tanning process. Our leather manufacturers must aim to be more than good machinists; they must be practical and thorough chemists. Already they have done much; and to one who knows them, and what their broad-minded and progressive efforts have done for hides and leather, the future of that industry can never be in doubt. It will take its place far up in the ranks of the great industrial enterprises of America.

Robt. H. Foerderer.

CHAPTER LXXVI

AMERICAN RUBBER MANUFACTURES

THE rubber industry in the United States can hardly be said to have had any real and tangible existence until the discovery of the process of vulcanization, a little over fifty years ago. It may, however, prove not uninteresting to go back a half-century earlier, to the very beginnings of rubber history in this country; for the first half-century of this industry, though it achieved little else than failure, is, perhaps, fully as instructive as the last half-century, which has been marked with such constant and conspicuous success.

The first rubber ever imported into this country was brought into Boston in the year 1800. By a singular coincidence, Charles Goodyear was born this same year—the man who was destined to convert this useless sap of the Southern forests into a product that should contribute in a thousand ways to the comfort and wealth of humanity, and to the progress of science and art. While rubber was unknown, prior to this time, in the United States, it was by no means a product of recent discovery. Columbus found the natives of South America using it; and the Spanish soldiers, who followed in his wake, smeared their cloaks with the liquid gum, to make them waterproof. French savants, visiting the New World in the earlier part of the last century in quest of scientific information, took back accounts of the strange forest-trees whose sap could be molded into shoes which were as flexible as leather and as impervious to water as metal.

It was not, however, until 1770, that rubber was utilized in any civilized country; then a few pieces of it were sent to England to be used by artists for erasing pencil-marks. It is a singular fact that rubber derives its name from this trivial circumstance, the name "India" coming either from the fact that it was gathered by the Indians of South America, or, possibly, because some of the early importations into Europe came from India.

It may not be uninteresting to take a hurried glance at the nature of this substance, its origin, and the method of its collection. Rubber, in its crude state, is the sap of a tree which grows in great luxuriance in hot climates and in localities that are subject to annual inundation. This tree grows chiefly in Central and South America, western Africa, British India, and the Indian Archipelago. Two thirds of the rubber product of the world, however, comes from the Amazon region, and is known as "Para" rubber, deriving its name from the city of Para, at the mouth of the Amazon River, whence it is exported. The botanical name of the South American species is *Siphonia Elastica;* of which there are several varieties, ranging in height from forty to eighty or ninety feet.

The methods of gathering differ somewhat in the different countries. For instance, in Peru and in Central America the destructive method of felling the tree is pursued, cutting it into pieces, and letting the sap run into a hollow, from which it is gathered. The method in vogue along the Amazon, briefly, is this: Shortly after the rainy season is over—that is, in midsummer—the rubber gatherers take to their canoes, paddle up the tributary streams of the Amazon, build their little huts, and then start into the forest, making small incisions, with a little hatchet made for the purpose, in the bark of the rubber-trees, cutting each tree in a half-dozen or more places, according to its size. Beneath each incision a small clay cup is placed, being made to adhere by a daub of clay. Later in the day, the gatherer goes his rounds and empties the contents of each cup into a calabash, or earthen jug, which he carries back to camp. Then, building a fire of palm-nuts, he dips a wooden paddle into the adhesive sap and cures layer after layer in the dense smoke, continuing this process until the lump of cured rubber at the end of his paddle becomes inconveniently heavy, when it is cut open and put aside, ready for shipment. The sap of the tree, before it is cured, has the color and the consistency of milk. Its color as it comes to this market is gener-

ally a dark brown, the change being effected by the smoke to which it is subjected in curing.

The first rubber imported into this country, in 1800, came in the form of bottles, and was looked upon simply as an interesting curiosity. During the next twenty years, sea-captains coming from South American countries were constantly bringing with them specimens of "gum elastic," as it was then more generally called, not as an article of commerce, but simply as the strange product of a distant land. It was natural, however, that a material so pliable and elastic and so impervious to water should suggest to the active American mind great possibilities in the way of usefulness. But it was not until 1813 that this activity had any palpable result. In that year a patent was granted to one Jacob Hummel, of Philadelphia, for a gum-elastic varnish; of which, however, there seems to have been no further mention. Some ten years later, in 1823, a Boston sea-captain, coming from South American ports, brought with him a pair of gilded rubber shoes which excited the greatest interest. Two years later, 500 pairs of rubber shoes, made by the natives along the Amazon, were brought into Boston, this time without the fantastical refinement of gilding. They were exceedingly thick, clumsy, and unshapely shoes, and yet they sold readily, bringing from $3 to $5 per pair; for, with all their heaviness and awkwardness, it was found that they were a secure protection against dampness. This was the entering wedge for the Para rubber shoe. The next year more came, and each year the number increased, until during the next fifteen years probably over 1,000,000 pairs of these shoes were brought into this country and sold at these very considerable figures.

It naturally suggested itself to a great many enterprising minds that if rubber, when crude, had so little value (such lots as had already been imported had sold at five cents a pound), and when manufactured into shoes commanded so high a figure, there must be an excellent profit in rubber manufacture; and so people began to study the rubber problem. Among them was Mr. Chaffee, a manufacturer of patent leather in Roxbury, Mass. It occurred to him that if he could manufacture a leather with a varnish of rubber, which would give not only a smooth and finished surface, but would render the leather impervious to water, he would have a material of obvious usefulness. He began to experiment. This was in 1831. He soon discovered that by dissolving the crude rubber in spirits of turpentine and adding a quantity of lampblack, he obtained a varnish which, when spread over leather or cloth, gave a hard, smooth, impervious surface. He was enthusiastic over his discovery, and so were his friends. A company was formed, and the Roxbury India-Rubber Company, the first to engage in rubber manufacture in the United States, was organized and received its charter in 1833. The prospect for a very large and lucrative industry appeared most promising. They began to make not only rubber-coated shoes, but rubber cloth, rubber life-preservers, and various other articles. Other companies were started in the vicinity of Boston and New York, and several millions of dollars were invested in this enterprise. In fact—to borrow a modernism—rubber "boomed"; for here was a new product made of the sap of a forest-tree, the supply of which was inexhaustible, and the uses of which, when manufactured, promised to be almost infinite.

In the winter of 1834, President Jackson visited Boston, and the managers of the Roxbury Company, having an eye to a good advertisement, presented their distinguished visitor with a suit of rubber clothes, which he put on—the day being rainy—and wore as he rode on horseback through the streets of Boston. It may well be imagined that the fame of india-rubber was notably increased thereby, and the demand for these goods became greater than ever.

Charles Goodyear, who was then a bankrupt hardware merchant of Philadelphia, had read about this wonderful new product and was greatly interested therein. Born in New Haven, the son of a Connecticut manufacturer, he had acquired by inheritance and by association a very considerable inventive ability. He had been in partnership with his father, conducting a branch store in Philadelphia for the sale of their Connecticut-made hardware; but owing to an over-extension of credits the firm had become insolvent, and Goodyear, then a young man but a trifle past thirty, found himself out of business and out of health, with a large load of debt upon his shoulders. He thought he saw in this new product, then being put upon the market, an opportunity to retrieve the family fortunes. Accordingly, on his next visit to New York he called at the office of the Roxbury Rubber Company and examined some of their goods, and particularly their life-preservers. He showed so much intelligence, in some improvements he suggested, that the agent, struck by his perspicacity, confided to him that the whole rubber industry, notwithstanding its seeming prosperity, was but a bubble that must burst—that the rubber shoes, and blankets, and coats, which the

factories had sent out in such large quantities were being daily returned to them, as the rubber melted and stuck in summer, and stiffened and cracked in winter. The man who could remedy these difficulties, said the agent, had a fortune in his grasp. Goodyear went back to Philadelphia determined, if possible, to solve the rubber problem.

It was a singular augury of the years before him that his first experiment in rubber was begun in a debtors' jail. Here, with a little lump of rubber, and with no other tools than his fingers, he began those experiments which were to continue until his death, some twenty-seven years later, and which, though for the most part carried on under circumstances of the utmost privation, were destined to add hundreds of millions to the wealth of the world.

The agent of the Roxbury Rubber Company proved a true prophet, for the great rubber industry which had sprung up so rapidly soon came to naught. The boots and shoes, and rubber clothing, and other articles made of the wonderful new product did not stand the test of actual service. The factories were soon closed and the investment proved an utter loss. But this general disaster did not discourage Goodyear. In a certain sense he was assisted by the absolute collapse of the enterprise, as it made crude rubber so apparently useless and so cheap that even a bankrupt in a debtors' prison could get all he wanted.

From this time, in 1835 and 1836, when in the entire industrial vocabulary there was no other word so despised as "rubber," until twenty-five years later, the history of the rubber industry in the United States is little else than the personal history of Charles Goodyear. There are many other names connected with rubber development, but they are all simply incidental; the one persistent, potent force was Charles Goodyear. Taking up the rubber problem as a possible means of paying his debts, he became so absorbed in the pursuit, so dominated by it, that from that time to the day of his death it was the one all-engrossing purpose of his life, from which no straits of circumstances, no distress of physical pain, no enticements of wealth, could serve to swerve him. It is impossible in the limited scope of this article to follow Goodyear through the ten years of trying and unceasing labors which were ultimately crowned by the discovery of the vulcanization process. They were ten years of groping in the dark, ever getting a little nearer to the light. Three different times he thought he had reached the goal—first, when he mixed his crude rubber with magnesia; second, when he boiled this compound in quicklime and water; and third, when he washed the surface of this mixture with nitric acid; but each time apparent success soon turned into complete and disheartening failure. It was six years from the time he began his experiments before he discovered that the two things necessary to make rubber an article of practical utility under all conditions of heat and cold were sulphur and heat. This discovery was made by accident—but it was such an accident as befell Columbus when he discovered America; it was only such an accident as could befall a man who had given his whole thought, his whole time, his whole being, to one subject for many years.

How he was sitting by the kitchen stove expounding his theories to his incredulous neighbors, and in the enthusiasm of his gestures struck a handful of rubber and sulphur against the hot stove, thus accidentally discovering the secret of vulcanization, has been told and retold so often that it need not be repeated here; and yet this wonderful discovery that heat was the thing that rubber needed to make it insensible both to heat and to cold—a discovery which meant to Goodyear the triumphant solution of the problem which had remained for so many years unsolved—signified so little to his friends—indeed, the entire community was so weary of the whole rubber question, and men of means viewed the subject with so much suspicion—that it was not until two years later, in 1840, that he was able to interest any one in his new system of vulcanization. In that year he secured the assistance of two New York capitalists and built a factory in Springfield, Mass. Here, four years later, he took out a patent for preparing rubber by the process of vulcanization, and began to sell licenses for the manufacture of various articles under this patent. The license to manufacture rubber boots and shoes was sold to Leverette Candee, of New Haven, the founder of L. Candee & Co., a company which has continued to the present time an important factor in the American rubber footwear industry. The license to manufacture rubber gloves he granted to the Goodyear's India-Rubber Glove Manufacturing Company, of Naugatuck, Conn. The license to manufacture door-springs, which seemed a very trivial branch of the industry, but which later grew to considerable proportions, was granted to Daniel Hodgeman, of New York; and various other licenses for the manufacture of other goods were given out under his patent to different companies, which immediately began the manufacture of rubber goods under these licenses. All branches of the rubber

Charles L. Johnson.

business as we find it in this country to-day took their permanent rise from the date of Goodyear's patent. Several other companies, in addition to the Candee Company, bought licenses to manufacture boots and shoes; among them Ford & Company (now the Meyer Rubber Company), and the New Brunswick Company, both of New Brunswick, N. J., and the Hayward (which later grew into the Colchester Rubber Company), and the Goodyear's Metallic-Rubber Shoe Company, of Naugatuck, Conn.

Mechanical goods, and especially belting, began at this time to receive considerable attention. Some rubber garments were also made. An immediate demand for the poncho—a blanket for horsemen, with a hole in the center for the rider's head—came from the far Southwest and from Mexico; and various druggists' sundries also began to find their way into the market. With the discovery of hard rubber the field of rubber's usefulness was still further largely extended. The prosperity of the early rubber companies which took their rise from Goodyear's patent in 1844, was sufficient to warrant them in paying Daniel Webster, who defended the patent in a seven years' lawsuit—,finally adjudicated in 1852,—a fee of $25,000—the largest legal fee that had at that time been paid in this country.

Still it was the day of small beginnings, for we find that the importations of crude rubber at Salem, Mass., to which port the greater part of the rubber then imported was brought, amounted in 1851 only to 334,000 pounds, in 1852 to 1,961,000 pounds, and in 1854 to 2,055,000 pounds. In 1860 the boot and shoe industry had a yearly output of only 1,200,000 pairs, at a valuation of $795,000.

The Civil War gave a great impetus to the rubber industry. This was particularly true of the clothing branch; blankets were needed for the soldiers, and the government gave out large contracts. The attempt was made, and with some success, to construct rubber pontoons to be used in military operations. The boot and shoe industry increased rapidly with the other branches of rubber manufacture, so that, from an output in 1860 of the value of $795,000, the yearly output in 1870 had increased to $8,000,000.

The manufacture of mechanical goods took a rapid start shortly after the war. This was owing to a considerable extent to the great increase of railroad building at that time. The railroads called for large quantities of packing, and for hose to be used in conveying steam and gas. The impetus given to manufacturing in general made an increased demand for rubber belting. The first rubber belt was patented in this country in 1836, but this particular branch of the rubber industry reached no considerable size until after the war, when rubber belting was in demand for mills, factories, and elevators, and especially for all outdoor machinery. It possessed several advantages over leather belting: its lower price, the greater friction between the belt and the wheel, and the fact that it was not affected by exposure or by moisture. The rubber mechanical goods industry has increased constantly from the time of the war to the present day, until now it covers a vast variety of articles.

The making of rubber tires for bicycles, and to a growing extent for other vehicles, took its rise about fifteen years ago with the solid tire. That gave way to the cushion tire, which some five years ago was displaced by the now universal pneumatic tire. It is estimated that at least 6,000,000 pounds of rubber are now annually used in the making of bicycle tires. Next in importance to rubber tiring—which stands next to hose, belting, and packing—comes the making of rubber mats. This industry has enjoyed a constant and rapid growth, until we have mats for floors and for stairs, pitcher-mats for tables, and coin-mats for counters—and all in an infinite variety of design. They have lately come into vogue in the form of tiles, which can be laid in ornamental mosaics, and are particularly adapted to ship use.

The introduction and rapid growth of the typewriter industry has consumed a constantly increasing quantity of rubber in various details of typewriter construction. The humble carpet-sweeper consumes, it is said, over $100,000 worth of rubber yearly in the bands that encircle it to keep it from injuring furniture. Several hundred thousand pounds of rubber are used each year by one company alone in the manufacture of jar rings. The making of pencil erasers consumes a large quantity, and there is a large annual output of goring, in which rubber thread is used. A quarter of a million dollars' worth of rubber is used in this country each year in the making of cushions for billiard-tables.

Probably the most widely extended branch of rubber manufacturing—existing to some extent in almost every civilized country—is the making of rubber stamps. This is a large industry in this country. Then the item of rubber balls is a very considerable one. One firm alone makes over $100,000 worth a year of tennis-balls, and it has several competitors. The making of base-balls and foot-balls, and the various foot-ball accoutrements in which the player arrays himself, consumes con-

siderably over $1,000,000 worth of rubber each year.

There are, in short, to-day, some thirty companies making rubber mechanical goods, with an aggregate capital of about $20,000,000, employing 4000 men, and having an annual output valued at from $18,000,000 to $20,000,000. Our export trade in mechanical goods amounts to something over $1,000,000 a year.

The attempt to utilize the waterproof properties of the caoutchouc gum in the manufacture of clothing was one of the earliest directions which rubber invention took. In England this branch of the industry has received more attention than any other; but in this country very little was done in this department of rubber manufacture until the Civil War, and the great demand to which it gave rise for rubber coats and blankets. After the war rubber coats continued to be made, but they were chiefly of a heavy sort and almost solely for men; women continued their vain attempt to protect themselves against the rain by the use of heavy woolen garments, most inaccurately called "waterproof." These gave way about twenty years ago to the light gossamer garment, which was at first very popular. But excessive competition resulted in such deterioration of quality as seriously to affect its popularity. About twelve years ago the manufacture of mackintoshes for both men and women was started in this country. Some garments had been imported from England, but they were not found perfectly suited to our drier climate. The American mackintosh has grown constantly in excellence and in general esteem, until now there are some twenty factories engaged in this branch of manufacture, with an investment of $6,000,000, and an annual output amounting to about the same sum. Of the several companies making rubber garments, the American Rubber Company, Cambridgeport, Mass., leads with a daily capacity of 1500 garments.

Another important branch of the rubber industry in the United States is the making of druggists' sundries. The pioneer in this industry was the Union Rubber Company, located in Harlem. It derived its license direct from Goodyear, and began to manufacture druggists' sundries early in the fifties, making syringes, water-bottles, bandages, air-pillows, air-cushions, and a variety of other druggists' articles. The atomizer, now so generally in use, was a later development, and came into vogue perhaps a dozen years ago. We do a fair export business in certain varieties of druggists' sundries. There are some ten companies engaged in this branch of the business in this country at the present time, with a capital of between $4,000,000 and $5,000,000, and with an annual output of about $4,000,000.

The hard-rubber industry, while somewhat distinct from the soft-rubber industry, may properly be included in the scope of this article. After Goodyear had brought his vulcanization process to a fair degree of perfection he turned his attention to the making of hard rubber, in which he was greatly assisted by his brother Nelson, who in the year 1851 obtained a patent for the production of hard rubber. Hard rubber differs from soft rubber in its composition—containing a much larger proportion of sulphur—and in the degree of heat used in vulcanization, which is considerably higher than that at which soft rubber is vulcanized. The first article made in hard rubber to any considerable extent was the comb. It is said that Goodyear's first experiments in this line made his combs cost twenty times as much as the ivory combs then in use; but the rubber comb has now practically displaced all other kinds. Probably five hundred varieties of rubber combs have been made since the beginning of this industry.

For twenty years after the invention of hard rubber two companies practically enjoyed its monopoly—the India-Rubber Comb Company and the American Hard-Rubber Company; but other companies entered the field after the expiration of the Goodyear patent, and now there are four large companies, employing 2500 operatives, having an aggregate capital of $4,000,000, and a yearly output of over $3,000,000 in value. The principal articles of manufacture are combs, syringes and syringe fittings, fittings for pipes, buttons, harness trimmings, and various desk articles, such as ink-wells, penholders, and rulers. We do a small export trade in this branch.

It is the boot and shoe industry, however, that has led in rubber manufacture in this country from the very first. In fact, for many years the boot and shoe industry used the great bulk of the rubber imported into this country; but the later development of other branches of the rubber business has been so large that now the boot and shoe industry comprises probably not over forty per cent. of the rubber manufactured in the United States.

From an annual output in 1860 of the value of $795,000, the value of the rubber boot and shoe product grew in 1870 to $8,000,000, in 1880 to $16,000,000, and in 1890 to $24,000,000. There are now a dozen or more large factories engaged in the manufacture of rubber boots and shoes. They are the American Rubber Company, Cambridge, Mass.;

the Boston Rubber Company, Boston; the Boston Rubber Shoe Company, Malden, Mass.; L. Candee & Co., New Haven, Conn.; the Goodyear's Metallic-Rubber Shoe Company and the Goodyear's India-Rubber Glove Manufacturing Company, Naugatuck, Conn.; the Jersey, Meyer, and New Brunswick Rubber Companies, located at New Brunswick, N. J.; the Lycoming Rubber Company, Williamsport, Pa.; the National India-Rubber Company, located at Providence, R. I.; and the Woonsocket Rubber Company, with three factories in Rhode Island—two at Woonsocket and one at Millville. The combined daily capacity of these companies is 180,000 pairs of boots and shoes, they employ 15,000 workmen, and their aggregate capital is $45,000,000. Their aggregate annual output in 1895 will equal 40,000,000 pairs of boots and shoes, valued at $29,000,000.

In Europe there are some eight factories manufacturing rubber boots and shoes—two in England, one at Paris (owned and managed by Americans), two in Germany, and three in Russia. The aggregate daily capacity of these eight companies does not exceed 30,000 pairs, as against the 180,000 pairs which the American factories can daily produce. The boots and shoes made by the European factories are uniformly heavy, and present few varieties in widths, sizes, or shapes; while the industry has been carried to such an extent in this country that several of the larger companies make—taking into consideration all the different shapes and sizes—fully a thousand varieties of rubber footwear.

There are several reasons why this country has so greatly outstripped Europe in the making of rubber boots and shoes. In the first place, labor being much higher here, we have had a greater incentive for making inventions and improving our machinery. Secondly, the great body of the working-people in this country are better able to afford the luxury of rubber footwear than they are in Europe, so that the demand is vastly greater here. In Europe rubbers are worn only by the well-to-do; here they are worn by every one, the yearly average consumption being a pair of rubbers to every other person. Then possibly our climate, with its more intense winter severity, has had something to do with our greater consumption.

We have as yet done comparatively little in the way of exporting rubber boots and shoes, our annual exports in this line rarely exceeding $300,000. The reason has been chiefly that the American demand has been so large and has so constantly increased that our manufacturers have not yet felt the necessity of looking for a broader field. They have consequently made no effort to appeal to foreign buyers by making rubbers particularly suited to their local conditions. The rubbers which we export go chiefly to England, the Continent, Japan, and China.

A very important event in the history of the rubber boot and shoe industry in the United States occurred in the fall of 1892, when the United States Rubber Company purchased nearly all of the large rubber footwear interests in the United States. This centralization of the rubber industry has already resulted in conspicuous economies; for while the different factories have remained under their former individual management, they have shared their individual advantages in common, the patents and secret processes of one factory becoming the property of all. In this way all the improved methods, a part of which each factory enjoyed before, are now shared equally and fully by all the different factories. There has been also a great saving in the matter of purchasing crude rubber, a large single purchase being made at a great advantage over a number of smaller scattered purchases. In reducing the necessity of carrying large stocks, in diminishing the duplication of a vast number of expensive lasts, and in various other ways, marked economies have been effected, while at the same time the quality of the goods has been more uniformly excellent than heretofore. The combination of all that was best in the methods of the different companies has proved a potent agency in advancing the rubber footwear industry in this country toward the universal goal of all industrial enterprises—better product at a lower cost.

The entire rubber industry in the United States, in its five important branches,—footwear, mechanical goods, clothing, druggists' sundries, and hard rubber,—consumes considerably more than one half of the rubber manufactured in the world. The consumption of rubber in this country increased from 9,830,000 pounds in 1875 to 17,835,000 pounds in 1880, and 31,949,000 pounds in 1890; while the consumption of crude rubber in 1895 will aggregate fully 36,000,000 pounds. To this large amount must be added the rubber which is obtained by the reclaiming process, which has now been brought to such a state of perfection that very little rubber goes to waste, old rubber articles being collected and subjected to a process which eliminates from the compound everything but the rubber. This reclaimed rubber is serviceable in several branches of manufacture, and is largely used in certain

mechanical goods, in which the product is benefited rather than impaired by its use. It is probable that the amount of this reclaimed rubber used annually in this country equals 25,000,000 pounds, making the total yearly consumption of rubber 60,000,000 pounds. The rubber industry in the United States in 1895 is ten times what it was in 1860, three times what it was in 1870, and has doubled since 1880. There are $85,000,000 of capital invested in the various branches of rubber manufacture in this country, and the value of the yearly product is fully $75,000,000, while 150,000 people depend upon it for their support.

Almost the entire rubber output of this country is used at home, our exports amounting, all told, to less than $2,000,000 a year; but with our improved machinery and superior methods of manufacture, it is only a question of time—even though we pay nearly seventy per cent. more for our labor than is paid in Europe—when our export trade should assume large proportions. As soon as American manufacturers feel the need of a larger market, and will sufficiently direct their attention to foreign fields to make the boots and shoes best adapted to climatic conditions and local preferences, there is no reason why our export trade should not reach an importance more nearly commensurate with the large dimensions of our home consumption.

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CHAPTER LXXVII

AMERICAN WALL-PAPERS

JUDGED from the value of its product in dollars and cents, the wall-paper industry ranks very low in the list of American manufactures. Considered apart from its monetary value, however, it assumes an importance that can hardly be over-estimated, due to the refining influence it exerts in decoration and home adornment. Wall-paper has become the key-note in the decoration of a room; it gives the tone. Carpets and furniture are subsidiary. Criticism is chiefly directed to the wall-paper. The design must be perfect, and its coloring harmonious. In fact, wall-paper has become practically indispensable in furnishing a room. It is now the custom to paper the walls of new houses as soon as completed, instead of submitting to bare white walls as formerly; and builders find that they can more readily dispose of houses whose walls are papered, and can, furthermore, obtain a better price for them, especially if there has been a reasonable exercise of taste in the selection of the paper. Another point in its favor is the fact that it can be quickly applied, the annoyance incidental to the decoration of a house being reduced to a minimum through its use; and time is always an important factor with the American people. It is, furthermore, a not unhealthful agent, the ingredients entering into its manufacture being mainly wood-pulp and pure clay; and, being comparatively inexpensive, it can be replaced easily and as often as desired.

Unquestionably the industry had its origin in China centuries ago. Europe commenced making wall-paper about the beginning of the last century, the goods produced being mainly imitations of tapestries and various fabrics which had, previously to that, been employed in covering walls. In fact, the best goods produced in Europe at this day are imitations of tapestries, velvets, silks, cretonnes, and leather hangings. In these classes of goods European manufacturers have reached a high state of perfection, imitating any particular fabric so closely that in many cases it is impossible to detect the difference. In this work they are most conscientious, not permitting the smallest detail to be slighted. This attention to artistic accuracy necessarily renders the work very laborious and expensive. The rates of wages paid in Europe are low, however, when compared with those paid in this country; otherwise the prices of such goods would be almost prohibitory. The high measure of skill acquired in the manufacture of these goods is due in great degree to the fact that several generations of one family follow the same occupation, the son receiving instruction in the art at an early age, and succeeding the father in identically the same line of work. This state of proficiency is seldom met with in this country, where the opportunities of advancement are so great that the young man is not willing to follow in the footsteps of his parents, but strives to improve his condition and, if possible, establish a business of his own. This brings about a scarcity of skilled labor which is seriously felt by every manufacturer having advanced ideas, and which retards the progress of the business to a large extent. A more liberal provision on the part of labor organizations for apprentices is absolutely essential to secure the best results. Low wages have, to a certain extent, acted against the progress of the wall-paper industry in Europe. They have caused manufacturers to retain primitive methods that are in strong contrast with those used in this country, where labor is better compensated, and where, in consequence, inventive minds have been at work to overcome, by improved methods and increased production, the higher rate of wages paid here.

According to the best authorities wall-paper was first manufactured in this country about the year 1790, so that a retrospect of the business for the last hundred years practically embraces the entire life of this industry here. Those who introduced the industry were two Frenchmen, Boulu and Charden,

in association with John Carnes, who had been the American consul at Lyons, France, followed shortly after by William Poyntell, and by John Howell and John B. Howell, father and son respectively, who had formerly conducted a similar business in England. The Howells established themselves at Albany, N. Y., but in a very modest way, their factory being a few rooms in the rear part of their dwelling. However, the amount of space required was not great, as the method of manufacturing was very crude, and the volume of business correspondingly small. Paper was at that time made only in sheets, and had to be joined before being printed. Color was then applied by means of a brush to form the background of the design, and the latter was subsequently printed upon the paper from wooden blocks, as many blocks being used as there were colors in the pattern, each block having a part of the pattern upon it in one color. One block was printed the whole length of the paper before the next color was applied. It should be stated that this method of printing by means of blocks still prevails, but only in connection with designs which, on account of their dimensions, or through some other peculiarity, cannot be printed on the cylinder-machines that have practically supplanted block or hand work, as it is termed. The method of applying color to the background by means of a hand-brush has, however, been done away with altogether.

It does not appear that any other factories were established until about the year 1810, at which time a man named Boriken was engaged in the business. The Howell firm had meanwhile sold out their Albany business to Lemuel Steel, and, after a short experience in New York City and Baltimore, had finally, in the year 1820, located at Philadelphia, Pa., where they have been established ever since, the present owners comprising the third and fourth generations engaged in the business.

It was not, however, until 1844 that any decided advance was made in the growth of the industry. About that time paper in continuous lengths came into more general use, and the necessity of joining sheets together was obviated. In that year, also, the first machine for printing wall-paper was imported from England and introduced into the Howell factory. While very crude, as it printed only a single color, it had a stimulating effect on the business, inasmuch as it enabled goods to be produced at a largely reduced price, and increased the volume of the business considerably. As near as can be ascertained, the entire production of wall-paper in the United States at that time did not exceed $250,000. The second printing apparatus was imported from England in 1846, this one printing six colors. Machines were subsequently built in this country, at first by the machinists connected with wall-paper factories, but after a time a specialty of this class of work was made by William Waldron, of New Brunswick, N. J. He was succeeded by his son, the present John Waldron, whose conscientious attention to the machinery requirements of the wall-paper trade has, during all this period, secured to him the bulk of the business in this line. Being of a highly practical mind and very observant, he has been quick to perceive possible improvements, and has, furthermore, been able to render practical the ideas of others.

The printing-machine of to-day is unquestionably a great improvement on that originally imported into this country, although the principle of its operation is practically the same. It is cylindrical in shape. The paper passes over the cylinder, the pattern being printed on it by means of rollers on which the design has been placed, each roller representing one of the colors used in the design. These rollers are registered so accurately that as the paper, in passing over the revolving cylinder, reaches one of them, it leaves the impression on the paper, and the succeeding rollers follow in regular order. The paper is hung up by an automatic process as it leaves the machine, and passes into drying-racks which are usually several hundred feet in length, after which it is rolled up in lengths of eight to sixteen yards, and is ready for market.

While the printing-machine is necessarily the most prominent feature of the business, yet other factors have contributed largely to the progress made by this industry. Among them are the grounding-machines, which furnish the background color to the paper; the bronzing-machines, which apply bronze powders to certain of the goods; the embossing-machines, which give various textures to the goods after they have been printed; the pressing-machines, which are used to make goods showing the design in relief; the machine or contrivance that is used to hang up the paper after it leaves the printing-machine; and a host of similar devices that enable the manufacturer to produce novel effects and manufacture the goods more rapidly than before, and at a lessened expense. It is these contrivances that have led to the tremendous progress achieved by this industry in the last fifty years, and more particularly within the last twenty years (the pace having been accelerated each year), which have enabled us to become independent of foreign

manufacturers, and, notwithstanding a reduction in duties on wall-paper, have caused a continued falling off in imports, so that at the present time importations of wall-paper are simply nominal.

The improvements referred to have, however, not been so radical at any time as to enable us correctly to apportion to each individual the credit to which he is entitled. They were such as were called for by the exigencies of the moment, slight at the time, but cumulative, and enabling the industry eventually to attain its present state of perfection. The most notable are as follows: (1) Soon after the introduction of the printing-machine one McKernan invented a contrivance for festooning the paper automatically as it leaves the printing-machine and passes on to the drying-racks. This was undoubtedly a long stride in the process of making wall-paper, inasmuch as the speed of the printing-machine could be increased to the full capacity of the drying-racks connected with it. (2) The single (or continuous) process of making wall-paper was introduced about the year 1870. Formerly the ground color had to be applied by one machine, after which the paper was dried and rolled up and next passed through the printing-machine to receive the impressions of the design thereon. In the continuous process the paper passes through the machine which applies a ground color for the design, and then passes through a drying apparatus that is termed a "hot box," or into drying-racks, and then automatically passes into the printing-machine which applies the colors of the design, saving a double handling of the goods and involving less waste. (3) The method of applying bronze powders to wall-paper automatically was introduced about the year 1872, although, as it was conducted in secret for some time by one or two firms, the discovery may have been made at an earlier date. This method reduced largely the cost of making bronze (otherwise termed gold) papers, and led to an increased demand and output of them. (4) The next and most recent discovery was the application to wall-paper of bronze powders in a liquid state; that is, mixed with an adhesive material (made from potato-starch) of sufficient density to keep the bronze powders in solution without impairing their luster. This was first placed upon the market about 1882, and as the new process enabled the use of as many different shades of bronze as there were colors in the design, the opportunity was afforded for producing many new and brilliant effects, and for superseding in a large measure bronze or gold goods made by the former method.

While, as before stated, it would be difficult to apportion to each individual the credit to which he is entitled for his share of the improvements to which attention has been directed, yet mention should be made of those who may properly be termed the pioneers of the business, and who by their energy and individuality have left their imprint on its history. The firm of Howell & Brothers has already been mentioned, and ranks as the oldest now in existence. Next among the firms that made a distinct impression on the business was that which was founded by Thomas Christie about the year 1835, and which had a most successful career until its dissolution in the year 1881. Mr. Thomas Christie, in connection with a Mr. Robinson, started his factory at Poughkeepsie, N. Y., and subsequently removed to a larger factory in Twenty-third Street, between Tenth and Eleventh avenues, New York City. Of the firms now existing that had their beginning about the time that wall-paper printing-machines were introduced are Janeway & Company, New Brunswick, and the Robert Graves Company, New York and Brooklyn. The firms of William H. Mairs & Company and Frederick Beck & Company, New York, began shortly thereafter, and all of these achieved decided success. They comprised men of ambition, perseverance, and the strictest integrity, and their success is but the result of these qualities. Among the firms who, for a greater or less period, claimed the attention of the trade were those of Josiah Bumstead, of Boston, Mass., and J. R. Bigelow & Company, of Boston, Mass.; and Whiting & Young, of New York City. Mention should also be made of those firms which, though established more recently, possess a distinct individuality, have been highly successful, and whose future career is assured. Prominent among these are Warren, Fuller & Company, William Campbell & Company, M. H. Birge & Sons, Henry Gledhill & Company, and Janeway & Carpender. This list might be extended indefinitely, for there are many others whose work and standing in the trade deserve commendation.

While the mechanical part of the business has made vast strides, there is yet another feature that outranks it in importance, and that is the artistic element. The American people have a constant craving for something new, and the manufacturer is taxed to the full extent of his powers to satisfy this demand. On no industry does this demand fall more heavily than on wall-paper manufacture, and by no occupation has the demand been more fully satisfied. To meet this call it has become necessary

to produce an entirely new line of goods each year. Imagine, then, the labor and expense necessary to reach this ever-heightening standard, the number of designers necessary to produce annually several thousands of designs, each entirely distinct from the other. But American enterprise is equal to every exigency. Formerly it was the custom to reproduce foreign styles of wall-papers, but we have outgrown that, and have distinct styles and methods of our own. We produce elaborate schemes of decoration, combining proper treatment of wall and ceiling so that perfect harmony of color will prevail. We offer these schemes of color and treatment not only in expensive grades, but in the cheapest grades as well. This makes it easy for the dealer or for the consumer to insure a well-decorated room, and one that cannot justly be subject to criticism. Talent of a high order is necessary to secure such results, and the staffs of the various manufacturers contain men of exceptional capacity, whose training and experience entitle them in the highest sense to the title of artist. The exhibit of the National Wall-Paper Company at the World's Fair at Chicago bears testimony to this fact, and the award of a gold medal is a recognition of the merit there displayed.

Statistics as to the growth of the industry are necessarily defective, but, according to the most trustworthy information obtainable, the following table gives some idea as to the progress made in the wall-paper business:

Year.	Number of Factories.	Capital Employed.	Number of Employees.	Value of Product.
1793......	1	Nominal	Nominal	Nominal
1810......	3	$30,000	75	$25,000
1844......	5	150,000	500	250,000
1880......	25	3,500,000	2,500	6,500,000
1890......	30	9,000,000	5,500	9,000,000
1895	35	12,000,000	7,000	12,000,000

Such is the record of the wall-paper industry at the present day. While its growth in the past has been remarkable, its growth in the future must be even greater, as the advantages of the use of the product become more apparent.

Henry Burn

William Steinway.

CHAPTER LXXVIII

AMERICAN MUSICAL INSTRUMENTS

FOR the introduction of the pianoforte, to which such an ennobling, educating, and progressively fascinating mission was intrusted, America is indebted to Europe. This instrument was invented almost simultaneously by Christophale, of Italy, about 1710, and Gottlieb Schroedter, of Germany, within a few years of that date, and was greatly perfected by Silbermann, of Strassburg, shortly afterward. The pianoforte did not come into general use until the beginning of this century, in either America or Europe. In London it was for the first time publicly played in the Covent Garden Theater in the year 1767. John Jacob Astor, of New York, imported from London the first pianofortes as early as the year 1784. They were small four and one half to five octave square pianos, having eight legs. Their tones were feeble and tinkling. Each piano had his own name on the name-board.

The few pianos which were used in the United States at the close of the last and the beginning of the present century were imported. In a short time, however, the trying climate of North America, with its ever-recurring dry land winds, its severe winters, and the general heating of houses by stoves and subsequently by hot-air furnaces exerted its destructive influence upon these instruments, which had been constructed for the comparatively uniform and moist European climate. Again, the great distance between the American settlements, scattered over so vast an extent of territory, with wretched roads, made it next to impossible to effect necessary repairs, even if trained and skilful piano repairers had been accessible; therefore to keep the instruments in anything approaching a playable condition was only possible in the largest cities. As a natural consequence pianos were articles of luxury, accessible only to the wealthy.

It was quite natural, then, that as the demand for pianofortes gradually increased, the enterprise of American manufacturers should have been directed toward their production here. The first successful attempt at building pianofortes was made in Philadelphia about the year 1790, by an American named John Hawkins. In the year 1802 he sailed to London, taking with him two upright pianofortes which he had manufactured, and exhibited them in London. One of these original instruments, preserved for over eighty years, was exhibited at the International Inventions Exhibition, South Kensington, London, in 1885, and there was personally examined by Mr. William Steinway, who could not but admire the ingenuity of this pioneer of pianoforte making in America. Drum and fife and military music were imitated in this instrument, which, though of no practical utility, showed great inventive genius.

There were one or two more manufacturers in Philadelphia at the close of the last century and the beginning of the present one, but not until the close (1815) of the second war between England and the United States was the industry of pianoforte making taken up as a distinct American manufacturing feature. From the close of that war till about the year 1825, a great business depression prevailed in Great Britain. In consequence a number of young and skilled English piano makers and artisans emigrated to the United States and began manufacturing pianofortes. Among them were Robert and William Nunns, Geib, Stoddard, Morris, and others. Pianofortes were gradually extended in compass from four and one half and five octaves to six octaves; but up to about the year 1830, none were larger than six octaves, all being of square form.

About 1825 the first steps of improvement in American piano making may be traced. In that year the first successful attempts were made to give the body of the instrument more durability and an increased power of resistance against the "pull" of the strings, by the application of a full frame of cast-iron in place of one of wood, which had before been used.

The object of this brief synopsis is to describe the enormous dimensions to which the manufacture of pianos has grown in the United States, and the excellence which has been attained, making the American piano a standard which has been recognized by all Europe for a number of years. Consequently, only those inventions can be mentioned which, by their practical and lasting value, have aided materially in the development of this branch of art industry. It must be mentioned, however, that a careful search of the records of the United States Patent Office from its beginning has revealed the fact that a large number of most interesting inventions have there been filed, which, though impracticable in themselves, prove that for nearly one hundred years there has existed a constant and earnest endeavor to improve the manufacture of pianofortes in North America.

In the year 1825, Alpheus Babcock, of Philadelphia, obtained a patent for the construction in a square piano of a cast-iron ring, somewhat resembling the shape of a harp, for the purpose of increasing its power of resistance to the "pull" of the strings. By this invention the principle was first practically introduced of casting the iron hitch-pin plate in *one piece* with that portion which supported the wrest-plank.

In the year 1833, Conrad Meyer, of Philadelphia, exhibited at the fair of the Franklin Institute in that city, a six-octave square piano which was constructed with a full cast-iron frame, substantially the same as that used at the present time. This original instrument, still in perfect condition, was exhibited by him, together with his new pianos, at the Centennial Exhibition of 1876. The successful introduction of this full iron frame was aided to a great extent by the excellence of the quality of American iron and the perfection to which the art of casting had already attained in the United States at that period. It may be mentioned here that as far back as the War of 1812, cannon using thirty-two-pound and even forty-eight-pound balls had been successfully cast in the United States and effectively employed in that war, while in Europe nothing heavier than eighteen-pounders were known.

By the year 1837, Jonas Chickering, of Boston, who was born in 1800 and died in 1853, had greatly perfected the application of the full iron frame in square pianos. It was indisputable that the iron-frame pianos thus made stood better in tune than those previously constructed; but one great defect was that they had a thin and disagreeably nasal character of tone. For this salient reason the new invention soon had quite as many opponents as admirers, so that until the year 1855 all the New York, Philadelphia, and Baltimore pianoforte manufacturers made no attempt to utilize it. In fact, before 1855 not one of the prominent manufacturers outside of Boston employed the full iron frame in the construction of his instruments; but all the pianofortes manufactured in Boston at that time had a full cast-iron frame, of which the wrest-plank bridge was a portion. Across the acute edge of this iron bridge were laid the strings, which were generally exceedingly thin. The action used in these pianos was, without exception, what is styled the "English action," having a somewhat "dragging" touch.

In New York, on the contrary, the instruments made were provided only with a small cast-iron hitch-pin plate, and the "French action" had a more direct and prompter touch. They differed from the Boston pianos in possessing a much fuller and more powerful tone, though at the same time with a quality which was less singing. The New York piano makers succeeded in giving their instruments the capacity of standing in tune more permanently than had been previously accomplished, by a greater solidity of construction and a heavy wooden bracing of the case, and more particularly by the use of a solid bottom or bed of wood fully five inches in thickness, which, however, to some extent marred the elegant appearance of the instruments. By degrees a new difficulty manifested itself in the instruments thus made, for, as their compass gradually extended and finally reached seven or seven and one-third octaves, it was found impossible to obtain the necessary power of resistance against the "pull" of the strings, even by the most solid construction of the case, if wood alone was the material used.

At that time (1850–55) the principal pianoforte manufacturers were the Chickerings, Lemuel Gilbert, Hallet & Davis, Woodward & Brown, of Boston; Nunns & Clark, Stoddard & Morris, Bacon & Raven, Horatio Worcester, John B. Dunham, J. C. Fischer, Light, Newton & Bradbury, Albert Weber, Adam Gale, Hazelton Brothers, Steinway & Sons, and Haines Brothers, of New York; Conrad Meyer and Schomacker, of Philadelphia; Knabe & Gaehle, of Baltimore; and Boardman & Gray, of Albany. There were a number of minor manufacturers in New York and Boston and their vicinity, but with few exceptions their firms became extinct many years ago, and other successful manufacturers—Decker Brothers, George Steck & Company, Ernest Gabler, Kranich & Bach, Sohmer & Company, and

others—took their places. In the year 1849 a German named Mathushek, who was a highly skilled piano maker, was engaged in John B. Dunham's piano factory. Mr. Dunham was one of the successful piano manufacturers then established in New York. Mathushek had invented the so-called "sweep-scale" (increasing at the same time the compass from seven to seven and one-third octaves in square pianos), which greatly improved the power of tone, but also increased the size of the instrument and weakened its durability by narrowing the soprano part of the wrest-plank.

The Steinway family had arrived in New York on June 9, 1850, and the father and three sons (among them William Steinway, then a lad fourteen years of age) worked for nearly three years in different New York piano factories, familiarizing themselves with the requirements and tastes of the American musical community. Though possessing a reasonable amount of capital, they did not start in business for themselves until the fifth day of March, 1853, when, with cautious modesty, they placed their first shop in a rear building at 85 Varick Street, removing in 1854 to 88 Walker Street, New York. In 1855 they succeeded in constructing an overstrung square piano with a solid front bar and full iron frame, the latter covering the wrest-plank, the wrest-plank bridge, however, being made of wood. Without describing in particular the novelty of the instrument, it may be said that for the first time the overstrung plan—that of placing the bass strings obliquely across all other strings in the shape of a fan — was successfully introduced. The results achieved by this novel construction were in every way most successful. The instrument, by the unanimous verdict of the jury, received the first prize, a gold medal, at the exhibition, in 1855, of the American Institute at the Crystal Palace in New York. This was located at what is now known as Bryant Park, and was destroyed by fire in 1858. The new method of construction immediately became the standard for all American manufacturers and soon after for all other countries, and has remained so ever since.

As stated before, nearly all the pianos made in the United States up to the year 1856 were square pianos. Jonas Chickering, one of the leading pioneers of American piano manufacturing, in 1840 constructed the first American grand piano, successfully introducing the iron frame. A small piano manufacturer named Buttikoffer, a former workman of Erard, of Paris, France, also made Erard fine pianos entirely of wood; but the demand for grand pianos was so limited that the great pianist Thalberg, who arrived in the United States in the year 1856, brought with him two Erard concert grand pianos for his concert tour throughout the country. In 1859 Steinway & Sons made a great improvement by successfully introducing into grand pianos the overstrung system, which was secured to them by United States patent dated December 20, 1859. At the same time several other standard piano makers of New York, Philadelphia, Baltimore, and Boston commenced the manufacture of this kind of instrument, all of them with the overstrung system. Overstrung grand and square pianos were exhibited by Steinway & Sons at the World's Fair of 1862, in the Crystal Palace, London, taking a first-prize medal; and again overstrung grand, square, and upright pianos were shown by them at the great International Exposition of Paris in 1867, these being crowned by a first grand gold medal and the unanimous indorsement of the international jury. Messrs. Chickering, of Boston, also exhibited parallel-stringed grand and upright pianos and overstrung square pianos, and were also awarded a gold medal, so that America's triumph in the piano department was literally overwhelming.

The overstrung system was at once imitated by nearly all of the prominent manufacturers of Europe, and has ever since been known as the "Steinway" or "American system"; and the supremacy of the product of all first-class American piano makers has been conceded by the musical public of both continents. The importation of pianofortes from Europe into the United States not only practically ceased, but since that time the export of the American product to all parts of the civilized world has steadily increased, notwithstanding the somewhat higher prices. It must also be added that, practically speaking, almost all important novelties and inventions by which the tone and durability of all three styles, grand, square, and upright, have been enhanced and increased within the last half-century, have been made by American pianoforte manufacturers, all being imitated in Europe as soon as the details became known.

It may be interesting to state here that, up to the year 1850, England and France produced more pianofortes than all other countries, and supplied the European continent as well as the outlying colonies. Since that date there has been a marked change in that direction. Germany, which undoubtedly has, with America, the most skilled piano manufacturers and workmen, has nearly kept pace with the United States in the quantity of pianos manufactured, and

German piano makers were invariably the first to see the importance of American inventions and improvements. Only one old house in Paris and one old house in London still adhere to the antiquated system of parallel strings. All others have adopted the American overstrung system and full cast-iron frame. As far as can be judged, Germany, producing 70,000 pianos annually, has the largest export of pianofortes of any country in the Old World, especially in the cheapest class of instruments; and there is no doubt that Germany, although making at the present time more pianofortes than all other European countries combined, is surpassed by the United States of America, which, on a careful and conservative estimate, produce annually from 80,000 to 90,000 pianofortes.

The manufacture of pianos in the United States was formerly confined to the following four cities: first, New York; second, Boston; third, Baltimore; fourth, Philadelphia. Within a dozen years Chicago has stepped in, and now has become third in the number of pianos annually produced. The list is now: first, New York; second, Boston; third, Chicago; fourth, Baltimore; fifth, Philadelphia; and successful pianoforte manufacturers have also located in other large cities of the United States, such as Buffalo and Rochester, N. Y., Cincinnati and Norwalk, O., and Erie, Pa.

In Europe the manufacture of square pianos practically ceased about the year 1855, and only grand and upright pianos were thereafter made. In the United States, as mentioned before, the square pianoforte was, up to the same time, almost exclusively manufactured, and sales of grand pianos were about as scarce as angels' visits.

During the years 1844 and 1845 a French manufacturer named Henri Herz, who at the same time was a first-class pianist, traveled through the United States, giving concerts in the larger cities. He had brought with him a number of French upright pianos, and during his stay in this country imported many others. These were readily sold, but within a few years all succumbed to the influence of the climate and became total wrecks, from the fact of having been made from wood alone. This caused such a deep-rooted prejudice throughout the country against upright pianos that they became absolutely unsalable, and up to the year 1866 fully ninety-seven per cent. of all the pianos which were annually made in the United States were square pianos. In that year Steinway & Sons succeeded in completing a system of manufacture for upright pianos which produced instruments that were fully as beautiful in tone and as durable for use as the square and grand pianos. This was speedily followed by other standard American piano makers, some of whom made improvements of their own; and within a few years thereafter a complete revolution in the piano industry took place, so that the situation of to-day is exactly the reverse of what it was less than thirty years ago. The manufacture of square pianos has now almost entirely ceased. The annual production of American pianofortes consists of about ninety-five per cent. uprights, less than two per cent. squares, and a little more than three per cent. grand pianos. There is no question that by the year 1900 not a single square piano will be manufactured in the United States or any other part of the world.

Setting aside, then, the effects of the business depression of the year 1893, and, to some extent, of 1894, which fell with very much greater severity upon other branches of manufacture than it did even on pianofortes, American piano manufacturers have every reason to feel proud of the results achieved by them. There has not only been steady progress in the number of the pianofortes produced by them, but the art of piano making in the United States has been elevated to the highest perfection—a fact which is recognized all over the world.

Quite a number of good European pianos were exhibited at the Centennial Exhibition in Philadelphia in 1876, and at the Columbian World's Fair in Chicago in 1893; but none of them were sold, and all of them had to be reëxported. No grand piano of foreign make has ever been publicly heard in the United States since the advent of Thalberg, now nearly forty years ago; but many first-class American concert grand pianos have been, and are at present publicly used in the art centers of Europe by the greatest artists. Besides, the five largest piano manufacturing concerns in the world are located in the United States. They are: two at New York, one at Chicago, one at Boston, and the fifth at Baltimore. This is indeed a proud and unique position, and American piano manufacturers have no reason to complain of anything in their industry, with one exception, as follows:

In 1850 the overwhelming majority of piano artisans were of American nativity, while since that time, and now for many years, almost all of them are either foreign-born (mostly German) or the direct offspring of foreign-born parents, who, by permission of the employer, are taught a certain single branch of the business by their fathers. This is much to be deplored, for American boys, many of them extraordinarily intelligent and ingenious, are

practically kept out of this important industry through what might be called the force of circumstances. As far as can be learned there is now no effective apprentice law in force in any of the States. This is very different from the conditions existing in Europe. Take, for instance, Germany. After having been released from school, say at the age of fourteen or fifteen years, a boy is apprenticed to a master mechanic for six or seven years. It is true he receives his board and lodging, but he has to pay, say, $100 *lehrgeld* (learning money), in order to indemnify the "boss" for the time lost in instructing him, or for the defective workmanship and spoiled material which may result from his unskilfulness.

No American boy would be willing to be placed in the position of an apprentice for six or seven years, although that is the only way in which a business can be acquired thoroughly in all its branches and details. Thus there is no guaranty to any employer that a boy, after one or two years spent in learning a branch or subdivision of a business, will not leave him and shift for himself. To enact laws compelling a lad who is growing up to remain with an employer and make up in the later years of his apprenticeship the losses he has caused in the first years does not suit American ideas, and probably never will. Still this matter should engage the attention of all those interested in social problems, for our American boys are second to none in intelligence and practical ideas. And this, too, is one of the chief causes of the sad fact that in no civilized country are there so many young men who are unskilled as in the United States.

In 1850, when William Steinway, then aged fourteen years, arrived in New York, a very lamentable state of affairs prevailed in the pianoforte and other manufacturing industries. The city was still suffering from the effects of the cholera epidemic of 1849; there was but little ready money in the country, much being of the "wildcat" order; there were no sawing, planing, or other labor-saving machines to do the hard work required in piano manufacture, nor were there any elevators; all heavy loads having to be carried up and down stairs on the shoulders of the artisans.

The despicable "truck" system prevailed throughout the country. The skilled workman was not paid his hard-earned wages, which were from $6 to $10 a week; but he would receive, say, from $2 to $3 of his weekly earnings in cash, and some of the rest in orders on grocers, tailors, and shoemakers. The remainder would be retained by the employer, who acted as a self-constituted savings-bank for his employees, without paying interest, and sometimes not even paying the principal. William Steinway, at the age of seventeen years, lost all his savings of $300 by the bankruptcy of his employer, William Nunns, in 1853. There were piano factories and other manufacturers who each were thus constantly owing over $100,000 in wages to their workmen. By the year 1860 this reprehensible "truck" system had, however, entirely ceased throughout the country.

The Civil War, between 1861 and 1865, also caused the piano manufacturers great hardships and struggles. They lost nearly all their claims against piano dealers in the South; there was no immigration to speak of; skilled artisans were scarce, many of them having gone to the war; and in February, 1862, the workmen in New York instituted a strike for higher wages, in which they were perfectly justified. The currency had then depreciated, and all the necessaries of life and rents had risen enormously in value. The workingmen's demand for ten per cent. was readily granted. In May following they again demanded ten per cent. more on the increased wages, which was also acceded to. But in October, 1863, they had formed a large society, the Piano-Makers' Union, and suddenly demanded an augmentation of twenty-five per cent. on the twice-increased prices, being in all a raise of fully fifty per cent. on the original rates. This was simply impossible for the employers to grant, the more so as no increase whatever had as yet been made in wages in the same occupation in Boston, Baltimore, and Philadelphia.

For the first time in the history of piano manufacture the twenty-three piano employers were driven together by necessity, and met at Ittner's Hotel, where it was resolved to resist the demands of the employees. A committee of seven manufacturers (of which William Steinway was a member) was elected to receive the committee of fifteen who represented about 3000 workingmen then on strike. The spokesman of the employees first demanded the increase of twenty-five per cent., with payment for all the time lost by the strikers, and then announced the program mapped out by the leaders of the strike as follows:

"Gentlemen bosses, we, the piano makers of New York, will now assume control of the piano business. You shall no longer be permitted either to engage or dismiss any workman without our consent. You must pay us full wages irrespective of bad or good times. You must all pay the same wages, must not undersell one another, and must every Saturday afternoon submit your books to our inspection, so that

we may satisfy ourselves that you have strictly carried out our instructions. Now, gentlemen bosses, what can we report to our union as your response?"

The employers' committee were simply stupefied, when one of the manufacturers, Albert Weber (who died in 1879), a very quick-witted man, observed: "Gentlemen employees, your demands are exceedingly moderate; but in your very modesty you have omitted your most important point."

The spokesman of the employees inquired, "Well, and what might that be?"

"Simply this," returned Mr. Weber; "that every Saturday afternoon, when you have looked over the manufacturers' books, the employees shall go a-bowling, and that the bosses should be made to set up the tenpins for their workmen."

A deafening and unanimous roar of laughter followed this sally. It was the right word at the right time. The ice had been broken, and both parties were conciliated. Half an hour later a compromise was effected, that fifteen per cent. (instead of twenty-five per cent.) increase was to take place in wages, all other demands by the employees being withdrawn.

The truce, needless to say, did not last long; the strike broke out anew in February, 1864, and was completely put down, after a struggle of nine weeks, by the unflinching resistance of the United Piano Manufacturers. Another strike in 1872, to reduce the daily hours of work from ten to eight, was also defeated, and since then but few and brief strikes have occurred. One partially successful occurred in 1880. Those in 1886 and 1890 both brought defeat to the strikers. As a general thing a much kindlier feeling between employers and employees gradually arose, and has existed for a number of years past.

PRINCIPAL INVENTIONS OF AMERICAN PIANOFORTE MANUFACTURERS, WHICH HAVE BEEN MORE OR LESS ADOPTED BY AMERICAN AND EUROPEAN PIANO FIRMS.

1825. Alpheus Babcock, of Philadelphia, Pa., patented invention of a full iron frame in the form of a harp for square pianos.
1833. Conrad Meyer, of Philadelphia, construction of an iron frame in square pianos, except wrest-plank bridge, which remained of wood.
1837. Jonas Chickering, of Boston, Mass., construction of a full iron frame, with wrest-plank bridge (in square pianos) of iron, all in one piece—an important invention, although his application for a patent was unjustly rejected for alleged want of novelty.
1840. Jonas Chickering, successful patented construction of the full iron frame with agraffe bar in grand pianos.
1849. Mathushek (with John B. Dunham), invention of so-called "sweep-scale" in square pianos, the compass of which he at the same time successfully extended to seven and one third octaves.
1855. Invention by Steinway & Sons, of New York, of the overstrung system and its iron frame, placing the strings in form of a fan, in square pianos.
1859. Invention by Steinway & Sons (United States patent, December 20, 1859) of the overstrung system, with its strings in fanlike shape, and novel construction of the iron frame, in grand pianos; also the square grand piano and novel agraffe bar (United States patent, November 29, 1859).
1862. Invention (United States patent) by Decker Brothers, of New York, of novel wrest-plank construction, increasing capacity to stand in tune, in square pianos; also novel apparatus to veneer round corners in square-piano cases.
1866. Invention (United States patent, June 5, 1866) by Steinway & Sons of double iron frame and patent resonator (controlling tension of sounding-boards) in upright pianos.
1868. Invention (United States patent, August 16, 1868) by Steinway & Sons of tubular metallic action-frame in grand and upright pianos.
1870. Invention (United States patents, March 15, 1870, and August 15, 1870) by George Steck & Company, of New York, of the self-supporting, independent iron frame.
1872. Invention by Steinway & Sons (United States patent, May 28, 1872) of the iron cupola and pier frame; also the grand duplex scale (United States patent, May 14, 1872).
1874. Invention by Steinway & Sons (United States patents, October 27, 1874) of the tone-sustaining pedal. The same year Mr. Hanchett, of Syracuse, N. Y., brought out (United States patent) a novel apparatus for prolonging the tone.
1875. Invention by Steinway & Sons (United States patents, October 20, 1875) of concert grand with *capo d'astro* bar all cast in one piece, and design thereof.
1878. Invention by Steinway & Sons (United States patents, May 21, 1878), bending into form the entire case of grand pianos, composed of a series of continuous veneers; also tone-pulsator in grand pianos; also *capo d'astro* bar in upright pianos.
1879. Invention by George Steck & Company (United States patent, January 7, 1879) of further improvements in self-supporting, independent iron frame.
1881. Invention by George Steck & Company (United States patent, October 18, 1881) of further improvements in self-supporting, independent iron frame.
1885. Invention by Steinway & Sons (United States patent, March 31, 1885) of double cupola iron frame in grand pianos.
1893. Invention by Henry Ziegler (nephew of William Steinway), of Steinway & Sons (two United States patents of November 21, 1893), of the grand piano with *capo d'astro* bar in upright form.
1894. Improvement by George Steck & Company in self-supporting, independent iron frame in upright pianos.
1895. Invention by Henry Ziegler, of Steinway & Sons (United States patent, January 8, 1895), of iron frame with *capo d'astro* bar and suspended wrest-plank in grand pianos in upright form.

After a careful and conservative estimate, it appears that there are now engaged in the production of pianofortes and their component parts upward of 200 manufacturing concerns established in the United States, representing a capital of over $40,000,000, and giving employment to about 40,000 skilled artisans; to say nothing of the many millions of capital invested in, and the many thousands of people employed by, houses engaged in the sale of these and other musical instruments.

Next to pianofortes no class of American musical

instruments has attained the prominence of the American reed-organs, the manufacture of which took distinct shape about the year 1850, commencing with melodeons in small square-piano shape, produced in great excellence by the late George L. Prince, of Buffalo, N. Y., Carhart & Needham, of New York City, and many other makers. These readily gave way to the superb reed-organs of Mason & Hamlin, of Boston, Mass.; the Estey Organ Company, of Brattleboro, Vt.; Burdett, of Erie, Pa.; the Fort Wayne Organ Company, of Fort Wayne, Ind.; and others too numerous to mention. Besides the interior capacity and the quality and quantity of tone, a variety of musical effects and the imitation of wind-instruments, as well as exquisite external workmanship, were introduced by these and other manufacturers. In good season, even before American pianofortes were exported, shiploads of these fine American reed-organs were sent to Europe, especially to Great Britain, Sweden, Norway, and other Protestant countries. Of late years, however, the importance of this branch of industry has diminished almost in the same ratio as the general interest in pianofortes has increased, the latter instrument becoming more and more popular. As the manufacture of the piano from year to year increased, the pianoforte, with its larger compass and its greater variety of expression, allowing full scope for the individual touch and for novel musical effects, has gradually taken the place of the organ. It has become the most welcome instrument in the American home and family circle, being especially fitted for accompanying the voice. Of late many of the standard manufacturers of American reed-organs have also gone into the manufacture of pianofortes, and several have been very successful.

Formerly, with the exception of banjos and mandolins, all small string and wind instruments had to be imported. All this, by the constantly growing perfection of the American manufacture of these articles, has been so greatly modified that the importation of these instruments does not now cut very much of a figure. At the present time fine harps, violins, guitars, flutes, and all kinds of wind-instruments are successfully produced in the greatest perfection by American manufacturers in all the larger cities of the country. They have greater durability, especially against climatic effects, than the imported articles, in which wood plays a part, can ever possess. Many millions of capital and thousands of skilled artisans are engaged in the manufacture of small musical instruments, and of late Chicago seems to make the greatest progress in this direction. Lyon & Healy, of that city, produce excellent small musical wind-instruments in large quantities, and their harps, which are of superb quality, are unexcelled by the best ones made in Europe. The latter are unable to withstand the effects of our severe North American climate for any reasonable length of time.

C. G. Conn, of Elkhart, Ind., and of Worcester, Mass., also produces most excellent brass wind-instruments in very large quantity. Vocalions, an English invention by Sir Bailey Hamilton, were first produced, and have been brought to high perfection, by Messrs. Mason & Risch, Worcester, Mass. Æolians are also extensively manufactured and sold. Within a few years autoharps, manufactured by Alfred Dolge & Sons, of Dolgeville, N. Y., have come into great favor, and are extensively produced.

The construction of church organs during the past fifty years has also reached large proportions in the United States. Everything is now manufactured, from the largest cathedral church organ down to the small portable pipe church organ. They are of the finest quality.

In all classes and kinds of musical instruments American ingenuity has achieved great triumphs and introduced many improvements, adding to the quality, and especially to the durability of the article, so that the importation of them has almost ceased.

William Steinway

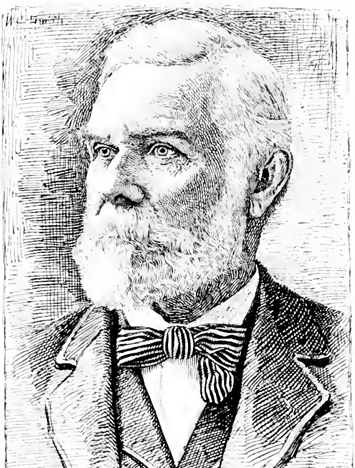
CHAPTER LXXIX

AMERICAN CARRIAGE AND WAGON WORKS

FROM the earliest times of which there has been any historical record, mankind has utilized wheels as a means of transportation. On the great sculptured stones now in the British Museum, taken from the ruined city of Nimrod near Nineveh, can be seen, besides the innumerable war chariots, carts drawn by oxen, and carts drawn by men. The writer made a drawing of one of the latter kind, which shows very good construction. The wheels have six spokes and are well proportioned; probably they were about forty-two inches high. The body is framed up with posts and a top rail, and the spaces are filled with handsome wicker work. There is an arched guard over the wheel to protect the latter from contact with the overhanging load. The cart is loaded with logs of wood. On another slab is shown the king's chariot, with an elegant canopy over the royal head. This chariot carries, besides the king, the charioteer and an arms-bearer. In Biblical history the chariot is very frequently referred to, those of the great army of Pharaoh being engulfed in the Red Sea. It is worth noting that the word "carriage" was at one time used in the sense of goods or baggage, and we find in the New Testament, "After those days we took up our carriages and went up to Jerusalem." The Greeks and Romans were, of course, familiar with the horse-drawn vehicle, and in the story of the Trojan war we find Achilles dragging the body of Hector around the walls of Troy lashed to his chariot. Carriages without wheels were used as late as the seventeenth century, when they were known as litters, having shafts behind and before which were supported upon the backs of the horses. The litter was but a form of the sedan chair, itself a species of carriage. If we look for a carriage with wheels but without horses, we find it in the jinrikisha of Japan, a unique vehicle drawn by man-power. The ancient chariot, with all its splendor of decoration, was but a two-wheeled cart without springs, and this, the starting-point in the evolution of the carriage, we find among many barbaric peoples, the wheels being formed of solid wood rendered circular when nature formed the trees from which they were made. Even the triumphal and funeral cars of early history were but springless carts; and ages of progress lie between a gorgeous chariot of the Cæsars and a modern buggy. Queen Elizabeth's wonderful state coach, with its highly ornamented and canopied body, was without springs. It was a sort of triumphal car, for State parades. Her usual mode of locomotion was by water or on horse-back.

The various forms which the modern carriage has assumed appear to be almost limitless. The old-time stage-coach has developed into the fashionable drag or tally-ho; the post-chaise and the curricle are no more; but there are still left to us innumerable forms of vehicles, of which the American buggy is perhaps the most useful and represents the highest development of the carriage-builder's art. Many of the forms came to us from England, notably the brougham, named for Lord Brougham. The landau takes its title from the town of the same name in Germany, where it was first made. A few specimens of the Irish jaunting-car have found their way to America, where they serve to remind us of the active nation with which they are popular. The hack as a name is solely American, but is of course a lineal descendant of the English hackney coach.

Carriage building, as an art, began to be developed in all parts of Europe about the middle of the seventeenth century. Steady but slow progress was made in all the great cities, and some almost elegant forms are shown in the old prints, profusely decorated. The running parts, however, were very imperfect. The first relief from the jolting of the dead-



CHAUNCEY THOMAS.

axle carriage was accomplished by suspending the body of the carriages on long leather thorough-braces stretched from upright iron jacks which stood up from each end of the running part. The next improvement was made by transforming these stiff iron jacks into spring jacks, and by making them of steel plates. Finally, in the early part of our own century, the spring jack was given a bold, sweeping curve, and the beautiful C spring evolved. The Collinge axle now in common use all over the world was perfected almost 100 years ago, and the elliptic spring, the best of all springs, was invented at about the same time. It was early in the eighteenth century that the post-chaise came into use for journeying, and the hackney coach and hackney cab came to take the place of the sedan chair in the great cities. This created quite a war in London between the watermen and the chairmen on the one side, and the coaches on the other.

In very old times the post-chaise had a small body hung very high on its leather straps; the wheels were very high and far apart, and the driver rode the wheel horse. In later times this uncouth post-chaise developed into the elegant chariot, perhaps the most perfectly formed carriage ever built. This carriage, with its gorgeously draped coachman's seat, as well as the full coach similarly mounted, is now only seen at royal receptions and other state occasions in the capitals of monarchical countries. As with other inventions, the evolution of the carriage has taken place by fits and starts, the greatest progress having been made during the present century, and the field in which that progress occurred having been the United States of America.

The volume of business done by American carriage-manufacturers in 1795 was exceedingly small. Technical knowledge was not wanting, however, for there were many shops which had been established in colonial days, where fine carriages were occasionally built, and many imported French and English vehicles repaired. But business languished for lack of customers. Before the War of the Revolution the rich shipping merchants of Salem, Boston, Newport, New York, Philadelphia, Baltimore, and Charleston lived in good style, as was common in those monarchical times, and imported in their own ships coaches, chariots, and phaetons, from England and France. Repair shops sprang up in all the large towns and cities, and skilled workmen came from England, Ireland, and Scotland, finding ready employment on their arrival.

A curious bit of history, clearly showing the use of carriages in New York City in 1770, came to the writer's knowledge some years ago from the late George W. W. Houghton, who embodied the facts in a lecture delivered before the New York Historical Society. The old record, which he somewhere discovered, gives a list of fifty-nine owners of carriages; and the vehicles mentioned were twenty-six coaches, thirty-three chariots or post-chaises, and twenty-six phaetons — in all, there were eighty-five vehicles. The names of the owners were Cadwallader Colden, Daniel Horsmanden, John Watts, Oliver De Lancey, Joseph Reade, Charles W. Apthorp, Colonel Roger Morris, Henry Cruger, John Cruger, James De Lancey, the widow of Governor James De Lancey, the widow of William Walton, the widow of Judge John Chambers, the widow of James McEvers, the widow Lawrence, Mrs. Waddell, Andrew Elliott, William Bayard, Nicholas Bayard, Philip Livingston, John Livingston, Robert G. Livingston, Walter Rutherford, Gerardus Beekman, Colonel Beekman, Nathaniel Marston, John Marston, Rev. Dr. Ogilvie of Trinity Church, Anthony Rutgers, Jacob Le Roy, David Johnson, William Axtell, Miss Lodge, Leonard Lispenard, Samuel Verplanck, Lawrence Kortright, David Clarkson, John Van Cortlandt, Robert Murray, James Jauncey, Dr. William Brownjohn, Dr. Jonathan Mallet, Thomas Tiebout, Jacob Walton, John Watkins, Nicholas Gouverneur, John Aspinwall, Hugh Wallace, Isaac Low, A. Van Cortlandt, Gerardus Duyckinck, General Gage, John Read, Archibald Kennedy, Thomas Sowers, Captain John Montressor, John Leake, Abraham Montier, and Ralph Izard. Many of these names are familiar to the New Yorker of to-day, the prestige of the old families having kept pace with the march of events.

It will be observed that there were but three styles of carriages known among the old aristocracy, and they were all for town use. No similar records are to be found in other cities, but there are many ancient relics of grand chariots now to be found in Boston and vicinity, still preserved in the stables of the old families as curiosities. One fine old chariot-body is now at the writer's factory, sound and serviceable. It was used by the owner's grandfather in London in 1793. The wheels and running-gear long ago disappeared, but the body is now being fitted with an elegant set of runners, and, when the first snow comes, will enter upon a new career of usefulness, completely rejuvenated as a stylish winter carriage.

The effects of the struggle for independence, and the hard times which followed, so impoverished the people that there was but little use for carriages of luxury in the early days of the present century.

The tendency of all classes was essentially democratic, and rigid economy was esteemed a great virtue. This state of things was not favorable for the makers of fine carriages; but, fortunately for them, all well-to-do people required something to ride in, and that took the form of the two-wheeled chaise, immortalized by Dr. Holmes. These were in great demand as the country grew prosperous, and were built in large numbers in Boston, Salem, Worcester, Pittsfield, West Amesbury, Mass., New London and New Haven, Conn., as well as in Wilmington, Del., and Philadelphia. They had enormously high wheels, and the tops were stationary, being supported on iron posts. Curtains of painted canvas or leather covered the sides and back. These chaises were often built without dashers or aprons in the earlier times, but in later years they had falling tops and were gay with silver plate. So universally was this style of carriage in use that most carriage-makers were known as "chaise-makers," as the old sign-boards of fifty years ago plainly indicated. Chaise-making throve mightily, and up to about 1840 it seemed that nothing could ever fully supplant the favorite old two-wheeler. But the buggy, which had been struggling for existence for several years, began to come to the front.

The chaise had been for generations of nearly the same form, no radical changes having been tolerated; but the buggy came in a multitude of forms, as it was new and without any recognized standard of shape to hamper the fancy of the builder. At last the door was open for novelties, and has since been still wider open, with no signs of being closed again.

The buggy is purely American in its origin, and is without doubt the greatest achievement of American carriage-makers. The body may be of any form, but the running part is always of the same, or nearly the same, type. Its common-sense construction is wholly unlike the work of any other country. It is simpler, lighter, stronger, and cheaper than any other style of vehicle, and is so admirable in all respects that it is not likely to go out of use for at least another century.

In the early days of this century of progress a great stimulus was given to the carriage and wagon trade by the advent of the grand old stage-coach. It was elegant in form, gay with paint and gilded scrollwork, and when starting out on its journey, rocking on its tough thorough-braces under its load of passengers and baggage, with its team of four or six Morgan horses, it was an inspiriting sight. It has been said that the stage-coach was unknown in America prior to 1810, but this is a mistake. In 1776 John Hancock stole away from his duties in the Continental Congress to Tamfield, Conn., where he married the beautiful Dorothy Quincy, and took her on a wedding journey to Philadelphia by stage-coach. The incidents of the journey, including the upsetting of the coach, are duly set forth in the record of William Bant, attorney to Governor Hancock. It is also related that Mrs. Hancock took a similar journey with her son, who was but two weeks old, to join her husband in Philadelphia. This was in 1778. The roads, however, at this early date, were little better than bridle-paths, and the chief resource for journeying was the saddle. In 1791 there were but 1905 miles of post-roads in the States, and in these roads were many bottomless sloughs, and corduroy bridges consisting of round logs laid crosswise over swamps, sometimes for long distances. As the government and local authorities improved and extended the roads, some sort of public conveyance followed.

In New York, New Jersey, and Pennsylvania the great Conestoga wagon, broad-wheeled, and with huge canvas-covered body, was drawn over the rough roads by six or eight horses or oxen for the transportation of freight and passengers. This wagon was the prototype of the famous "prairie schooner," or emigrant wagon, of later times.

Government roads, called military roads, were built across the mountains of Virginia, connecting the East with the valley of the Ohio; also through the great forests of Maine to the town of Houlton on the New Brunswick frontier, and in many other parts of the country. They were for postal and military purposes. On all these were quickly established thriving stage lines, and the business grew very rapidly. Capital was freely invested in the varied interests directly and remotely connected with the innumerable lines which radiated from all the chief towns and cities in the country; and the investments paid good dividends.

The carriage-maker, the harness-maker, the horse-breeder, and the jolly old country tavern-keeper, with his good dinners, his well-stocked and well-patronized bar, all seem to have been prosperous and happy in the good old slow-going time.

Stage-coaches and wagons were built in many places at the time I write of. Salem, Mass., was early in the field. Osgood Bradley, of Worcester, was a large builder; the Troy coach, of Troy, N .Y., was very famous in its day; but a little later, and still more famous, came the Concord coach, of Concord, N. H. The founder of the house of Abbott,

Downing & Company, now the largest wagon-builders in New England, whose work is known throughout America as well as in South Africa and Australia, was Louis Downing, who moved to Concord from Salem, Mass., in 1815. There he began the manufacture of coaches and wagons; and after eighty years, this old house is still in the full tide of active business.

So great was the coaching business from 1810 to about 1845, that in addition to the builders hundreds of smaller shops derived their chief income from repairing and painting these fine old road coaches.

After the War of 1812, trade and commerce entered upon a new career of prosperity. The shipping merchants were piling up wealth; manufacturing, which had grown strong by the fact that the war had thrown us wholly on our own resources, was opening up new sources of wealth, and again stylish carriages for city use were in demand. Fine coaches and chariots, hung on C springs, and made grand with the hammer-cloth coachman's seat, were built in all the large cities. Boston had two well-equipped shops for this kind of work; New Haven and Bridgeport were active and growing; Newark, N. J., became celebrated for its fine productions, and New York, Philadelphia, Baltimore, and Wilmington, Del., were supplying their own wants, and sowing the seeds of greater development in later times.

About this time a considerable export trade grew up with the West Indies. The carriages shipped there were known as volantes, and were large two-wheeled vehicles with immensely long shafts. The wheels were placed so far in the rear of the vehicle, in order to give greater freedom of access, that the shaft horse had a very large share of the weight upon his back. In addition to this, the overloaded beast carried the postilion, while the leader did most of the hauling. These carriages were shipped by the sugar and molasses merchants of the northern cities to the planters of the West Indies, in commercial exchange for their product, which was speedily converted into rum, then in great demand at home and abroad. Thus the carriage-maker played his part in the interchange of commodities, and trade flourished.

Farmers' wagons and carts had been made in every village in the country since the earliest time, but wagon-making as a great business began with the development of the Western States. First came the large emigrant wagon, and after that the lighter farm wagon, and, later still, wagons for the great overland current of emigration, which flowed like a mighty river from the East to the gold-fields of California. Happily for the emigrants, the wagon-makers of the West were equal to the occasion. Great factories quickly grew up, stimulated by this additional demand, and among the rest the great house of Studebaker Brothers, which had its origin as far back as 1813, now came to the front, reorganized and ready for business. This firm, now the largest wagon and carriage manufacturers in the world, was just in time to take a leading part in supplying the government with army wagons for the western regiments in the Civil War. It was due to the thorough equipment of the wagon-makers of the country that the armies of the North were better and more properly supplied with the means of transportation than any army in military history. Wagon-building is so vast in its proportions that when one visits such an establishment as that at South Bend, Indiana, he wonders where purchasers can be found for so many vehicles, a wagon being produced every ten minutes in this one factory.

The older men of the present generation of carriage-makers have witnessed a great change in the extent as well as in the method of manufacturing. In the early years of the century, business in the old carriage towns was done on what is called the "dicker" system. Woodworkers, blacksmiths, trimmers, and painters, each did business on his own account, and swapped parts, as they termed it, the final settlements being made in finished carriages. The dealer in materials also took carriages in payment. The workmen were paid with orders for goods, and money was almost unknown in all the various transactions. The old operators, who did business in this way, used to say that the plan was much safer than the cash system, there being fewer failures, and less danger of getting involved in debt.

By and by the small operators with their little shops went the way of all old-time things, and well-organized factories succeeded them. Then a multitude of inventions in machinery were eagerly taken up and utilized. Larger and larger grew the factories, more and more perfect the machinery, until the present time, when the limit of quick methods and cheap production seems to be well-nigh reached. But the end is not yet.

Much the larger number of carriages built in the great factories where machinery is employed are built in duplicate by the million, and are sold to the million at exceedingly low prices. Of course, there are many qualities among the vast variety of vehicles built by the new processes, and many

grades of stock enter into their composition. As in all other manufactures, the price is a very fair indication of quality. One might think that in the rush for low prices of both builders and buyers all really good work would be superseded by low grades, and that the tendency would be steadily downward in quality; but such is not the fact. Fine work — I may say superb work, that which taxes the highest skill and care of the best designers and mechanics — is still in great demand, and will probably continue to be for all time.

There are many builders of high-grade work widely known by the public, of whom I should be glad to speak, and who are distinguished for their excellent productions; but I will name only one, easily the first in this or any other country — Brewster & Company of New York. A visit to this great establishment — of which all American carriage-builders are justly proud — will show the appreciative observer to how high a degree of perfection, beauty, and completeness modern carriage-building has attained.

In 1872 the leading carriage-makers of the country formed an association called the "Carriage Builders' National Association." The good that this organization has accomplished by means of its annual conventions can scarcely be estimated. All trades which have similar associations know the value of good fellowship and good feeling among competitors instead of the old-time jealous antagonism. Very early in the history of the association the decay of the useful old apprenticeship system was recognized; and as a substitute for this past method of training workmen a fund was raised by subscription for a technical school, to be established in New York City, to teach the science of carriage drafting and construction. This school has been a great success. Under able teachers a large number of talented young men have graduated, well equipped to take charge of the constructive department in our factories. Thus scientifically trained foremen and whirling machinery now very largely take the place of the skilled workmen who formerly occupied our benches, each working by his own methods, carefully guarded, in which there was more of the rule of thumb than of science.

It is fortunate for the graduate of the technical school when, in addition to the knowledge gained in the course of his studies, he has the inborn faculty of producing new and beautiful forms; that keen sense of fair proportions and graceful lines which is the necessary qualification of a designer. Few things fashioned by human skill are more beautiful than a fine carriage; none but a true artist in his line is fit to determine its form, and none but an expert mechanic, painstaking and honest, is fit to supervise its construction. The light-weight carriages now required, the tremendous strain and rough usage which they must undergo without a sign of weakness, require the most carefully selected stock and the most watchful care in all the details of mechanical arrangement.

The volume of business done by all the carriage-makers in the country is clearly shown by the last census report, from which the following figures are taken:

AMERICAN CARRIAGE AND WAGON TRADE.

Number of establishments	4,571
Number of workmen employed	62,594
Number of all other employees	56,525
Officers, firm-members, and clerks	6,069
Capital employed	$93,455,257
Miscellaneous expenses	5,495,271
Wages of workmen	34,687,827
Wages of other employees	28,972,401
Wages of officers, firm-members, and clerks	5,715,426
Value of all products	102,680,341
Cost of materials	46,022,769
Value of road carts	6,074,173
Value of buggies	27,345,546
Other light carriages	13,109,982
Broughams, coaches, Victorias, etc.	4,279,738
Other heavy carriages	2,973,898
Light and heavy spring wagons, etc.	12,640,339
Farm wagons and carts	14,146,700
Repairing	18,610,366

It will be seen from the above figures that the value of buggies manufactured was double that of any other style of carriage or wagon, and more than one fourth of the total product.

That the volume of business done in the carriage trade at the present time is fully equal to the wants of the community is evident from the exceedingly sharp competition among builders and dealers. The business, however, will certainly continue to grow as fast as the increased capacity of the purchasing class can be made to absorb the increased product.

Given that prosperity which our country and her beneficent institutions insure us, if wisdom rules, a continued advance will be made, a wider and wider market will be open to us, greater novelties will be forthcoming to tempt the lovers of new things, greater perfection will be attained, and a greater number of our hard-working fraternity will find good employment with satisfactory returns.

Chauncey Thomas.

Willis B. Marvin.

CHAPTER LXXX

AMERICAN SAFE-WORKS

FROM the earliest period in history, the inventive genius of man has been applied to the work of providing safe receptacles for the storage of treasure, jewels, and other valuables. The development has not been so rapid as in some other industrial interests, but it has kept pace with the demands of the commercial world, and the evolution from the strong-box to the mammoth chilled-iron and steel vaults, absolutely fire-proof and burglar-proof, seems to have reached the highest stage that science and art can impart to the wonderful mechanism of American safe-building.

In the early days of Egypt the organization of government had attained a point of perfection which made its treasury an important interest, and the moneys obtained by the tax-gatherers upon the industries of the country were carefully guarded in securely-built treasure-houses fastened with locks of elaborate design and construction. From the keys which have been found in the ruins of Thebes it would appear that the ancient Egyptians were acquainted, even at this early period, with some of the principles which have been supposed to be distinctive in modern improvements in locks — for example, that of tumblers which hold the bolt fast until it has been moved by the key. Locks rudely constructed upon this principle were also to be found in many European communities during the middle ages, although its use by our modern safe-makers has been comparatively recent.

The discoveries in Pompeii and elsewhere have shown that among the Romans locks of intricate workmanship were known; and in Great Britain keys have been found which date back to the Roman occupation of that country. Among the Chinese the art of lock-making has for a long time been well understood, and the locks there constructed upon the principle of the famous Bramah lock, invented in England in 1784, were made of wood from early times. In these the tumblers were made of different lengths to fit the sizes of the wards in the keys.

During the middle ages chests for the safe-keeping of valuables were ordinary articles of furniture in houses. Some were very elaborately made, strengthened with ironwork of various kinds, and furnished with locks which were frequently decorated in very artistic ways. These chests, which were really the safes of that period, were protected by bands of iron. The burglar's skill and cunning had not then attained to its present perfection, and a modern "cracksman" would laugh at the provisions then made for the security of valuables. The oaken chest, or strong-box of that time, seems to have been considered the acme of security. In 1707 such a chest was made and used for the safe-keeping of the crown jewels of Scotland, and when the Royal Commissioners desired to examine them they were obliged to force open the chest, because no keys could be found that would open the locks, and no "expert" could pick them; yet they can be picked to-day by an ordinary expert locksmith in three or four minutes with a simple piece of bent wire. These safes or chests were often reinforced with iron bands and knees, and made to look more formidable with sharp-headed spikes or similar devices. No attempt seems to have been made to construct these articles to resist fire or heat, or to render them to any degree fire-proof, until between 1825 and 1835.

About that date the Yankee inventive genius produced an oaken chest that was a great improvement on the old style, and many of the old-time business houses in New York and Boston still have in their offices specimens of these first efforts of the inventive genius of America in the "fire-proof" safe line. A body of solid oak plank three or four inches thick, saturated with an alkali, was covered with sheets of thin iron. Bands of iron

were crossed and recrossed over these plates and secured to the body with large round-headed iron nails. This made a very formidable-looking affair, and with its immense key, weighing sometimes over a pound, was considered thoroughly fire and burglar-proof. As a fire-proof safe when new it would probably stand a severe test of two or three hours. In the great fire of 1835, which destroyed a large portion of the lower part of New York City, hundreds of these safes were shown to be worthless in a severe conflagration.

With the advent of paper money and the commencement of our modern commercial activity, wealth began to assume a more portable form; large values began to be possible in conveniently small packages, and the necessity was soon made apparent for improved methods in safe-making. The oaken box defended by iron bars, which had done duty as a burglar-proof safe during the last century, began in the early years of the present century to be replaced by boxes covered entirely with iron. The Hall Safe and Lock Company, of Cincinnati, have in their possession a safe formerly used by the Marietta Bank, and made in New York City in 1807, which is constructed of oak plank two inches thick, bound together by iron straps, and thickly studded with small nails. It is fastened by an ordinary hasp and padlock.

About the year 1820 the attention of safe-manufacturers, mechanical engineers, and inventors was directed toward making safes absolutely fire-proof, for the preservation of money and valuables. The first attempts appear to have been made in France. The safes were made with double walls, the space between them being filled with a non-conducting substance, a composition. This idea was quickly taken up in the United States, and in 1843 the first patent was issued to Daniel Fitzgerald, who had conducted experiments on his own account in the same direction. Fitzgerald had been a workman engaged in grinding plaster of Paris. A simple incident had suggested to his mind an improvement in the construction of fire-proof safes. Being in the habit of washing his hands daily in a tin basin, he one day desired to warm the water, and, placing the basin over the fire, discovered that it did not heat rapidly; and, after stirring the fire, he threw out the water, and discovered that a thin scale of plaster of Paris had gradually formed in the bottom of the basin. This he scraped out, and found that the water heated rapidly. He concluded that if a safe were filled with plaster of Paris it would be a good protection from fire, and he immediately secured a patent and began the manufacture of the first so-called Salamander Safes.

In a short time, as the business grew, he needed much more capital, and Mr. Azor S. Marvin was induced to engage in the business with him. A few years later Mr. Silas C. Herring also secured a right to manufacture safes under this patent. Mr. Fitzgerald's patent was subsequently assigned to B. J. Wilder, and the safes manufactured under it were known as the "Wilder Patent." In these the space between the walls of the safe was left vacant, reliance being placed upon the non-conducting properties of the air thus enclosed to preserve the contents from heat. Other substances, which had also a high non-conducting power, were proposed for filling the space left between the walls, and numerous patents were granted for various compounds.

But other inventors were also at work upon the problem of fire-proof safes, and asbestos, mixed with plaster of Paris, clay, alum, fire-clay, mica, and chalk were each used with effect, and were proclaimed in turn absolutely fire-proof. The intense heat, however, to which safes have been subjected has demonstrated that none of these fillings was absolutely safe. Another plan, invented by Prof. A. K. Eaton, of New York, consisted in using pure alumina, and he also introduced the idea of using steam as a non-conductor. Experiments showed that as long as any steam was produced no excessive heat reached the articles in the safe; but the objection to this is found in the dampness to which the contents of the safe are subjected.

Protection against burglars is in modern days regarded as of very great importance in the building of safes. The modern burglar has the thorough experience of a practical mechanic, together with a full comprehension of the details and theory of safe-making. During the present century great attention has been given both to lock-making and lock-picking. The invention of the Bramah lock was regarded as a step of great importance. The lock abandoned the use of wards, and other improvements introduced into its mechanism enabled it for a long time to retain its reputation as a lock that could not be picked. It was finally picked, however, in 1851, by a Mr. Hobbs, by what is known as the "tentative process." Subsequently the work of picking the lock became comparatively easy.

The next important lock invented was Chubb's, which was introduced in England in 1818. This was also picked with ease by Mr. Hobbs. A lock made by Mr. Pyes was placed in the London exhi-

bition in 1851, but it was picked by Linus Yale, Jr., of Philadelphia, by what he called the "impression process." The father of Mr. Yale then patented a lock which was regarded as absolutely safe, but it was finally picked by his son. The inventors persevered, however, and the modern lock-combinations are such as to defy the skill of the most accomplished or ingenious burglar, while the construction otherwise renders them absolutely fire-proof. The testimony of E. B. Denison, the celebrated lock-maker of London, demonstrates the superiority of American-made safes over those produced anywhere in the world. He says: "The American safes are vastly superior to any we have ever seen made in England; and on the whole the United States are evidently far ahead of us in the manufacture of both good and cheap locks."

The method of construction used in the modern safes makes them impregnable to any appliance in use by the most expert burglars. The doors, which are generally the weak point of a safe, are constructed of plates so dovetailed, and fitting correspondingly into the jambs, that the wedge, the most effective implement used by the burglar, is powerless against them, while the accuracy with which they fit offers no opportunity for any crevice into which nitro-glycerine or any other explosive fluid or substance can be introduced. The body of the safe being also constructed of alternate plates of iron, welded iron, and steel, carbonized and decarbonized steel, and crystal steel, fastened together by bolts from the inside, effectively prevents them from being forced by sledge-hammers, jimmies, jackscrews, or other mechanical devices. Their fire-proof qualities are also secured by fillings of concrete which make them absolutely proof against fire and damp.

But in addition to the building of safes much attention has been paid in recent years to the manufacture of burglar-proof bank vaults and chests. Among the specialties employed in their construction is a material made from Franklinite ore found in Sussex County, N. J., which possesses a hardness exceeding that of the finest tempered steel. This metal, often presenting the appearance of crystallized silver, is so interwoven with wrought-iron rods that it can be battered until bent without being broken, and at the same time the combination of wrought and crystallized iron is such that, in any attempt to drill, the tool will pierce the soft metal faster than the hard, and, consequently, working sideways, will soon have its point fractured and broken off.

A first-class banker's chest consists of three casings of one-fourth-inch wrought iron with angle corners, a casing of one-fourth-inch steel bars, a casing of one-fourth-inch wrought bars, with angle of solid corners, a casing of patent crystallized iron two inches thick, with wrought-iron rods cast through it, and projecting rivets on each side, so that the entire thickness is three and one fourth inches. Such a safe will not only overcome any drill or cutting-tool, but is also a restraint against sledging or battering, which has always been the weak point in safes in which hardened metal has formed an integral part. Many of the vaults in use in this city are receptacles for enormous sums of money and other valuables, the safety of which is rendered absolutely secure by the modern methods employed in their construction. The safety of hundreds of millions of treasure against the depredations of the most expert burglars, and also from loss by fire, is thus assured. One of the most important factors in securing absolute safety for valuables in bank safes and vaults has been the introduction of the combination-locks, the evolution of the "tumbler" principle already alluded to. The mechanism in these locks exhibits the highest skill. Each one is practically unlimited in the number of combinations upon which it may be set, thus rendering it absolutely impossible for any person, other than the one who knows the combination, to open it. In recent years a valuable addition has been introduced in the shape of chronometer or time locks. The mechanism and adjustment of these are as fine as the work of the most expertly constructed watch. Three movements are usually inclosed in a single case, so that, should one or even two of them get out of order, the remaining one would still unlock the ponderous doors at the hour appointed for them to be opened. Bank officers have in the past been compelled in some instances to unlock the door of a safe at the point of a burglar's revolver, under threat of death, but the chronometer combination has effectually prevented robbery in that way, as no human agency can open the doors of the safe or vault until the time on which it is set has expired.

The construction of the modern office building of fifteen or twenty stories has induced safe-manufacturers to build the framework of safes much thicker than was formerly the case, and to make use of greater quantities of fire-proof filling, so that the safes may withstand a fall from an upper floor to the cellar, and also the crushing weight of heavy walls and machinery.

There are at present about ten leading firms and corporations in the United States engaged in the manufacture of safes, vaults, etc. They give em-

ployment not only to mechanics, who are mostly of a very high class in the factories, but, in addition, large numbers of salesmen, draughtsmen, and others are connected with the work, aggregating upward of 5000 people, and producing annually in the neighborhood of $10,000,000 worth of work. The capital invested in machinery, plants, etc., for the production of this work approximates $6,000,000. Some of the principal manufacturing companies are located in the West, principally in Cincinnati: those include the Hall Safe and Lock Works, the Mosler Safe Company, the Diebold Safe Company; and in the East the Herring Safe Company and the Marvin Safe Company of New York, and the Farrel Safe Works and Remington Safe Works of Philadelphia. These companies all manufacture first-class work, and it is due to their energy and business activity that the American safe is the standard for the entire world. No foreign safes are imported to this country.

The immense superiority of the American over the European safes was shown in the great safe test at the Paris Exposition in 1867. An American safe was pitted against an English safe of one of the leading manufacturers of that country; the Yankee workman opened the English safe in less than three hours, while it took the Europeans more than double that time to open the American safe.

At the Centennial Exposition in 1876, the difference in the qualities and improvements shown in the American safes over the European exhibits was very marked, while the European safes were found to be but slightly in advance of those produced soon after the World's Fair in London, in 1850, and were about on a par with the safes produced in the United States twenty-five years previous. The American safes, in both fire-proof qualities and burglar-resisting devices and construction, were so far superior to all others that the foreign safes did not receive a single medal, or even honorable mention.

Naturally the recognized security offered by American safes opens the market of the world to the products of this important branch of industry. Not only throughout Great Britain and her colonial dependencies, but throughout Europe, Asia, Africa, and Mexico, the American safe-manufacturer finds customers; and great as is the volume of the trade to-day, the possibilities of the future cannot be foreshadowed with anything approaching accuracy, although its steady growth is assured.

W. B. Marvin.

Frederick G. Bourne.

CHAPTER LXXXI

AMERICAN SEWING-MACHINES

THE American sewing-machine is the sewing-machine of the world. Not only is this true as to the machines used for domestic purposes, but of machines used in manufacturing for stitching all kinds of textile fabrics and leather, including special machines for working buttonholes, eyelets, overseaming, embroidery, etc. It is, however, proper, in writing a brief history of the inception and invention of the sewing-machine from its beginning down to the advent of the first American sewing-machines which were of practical value as an article of commerce and trade, that we refer to what had been done in other countries in the way of inventing and producing sewing-machines.

The first sewing-machine of official record is that of Thomas Saint, on which a patent was granted in England, July 17, 1790. It is not known whether more than an experimental machine was made; only the drawings on file in the English Patent Office, together with a full description of the machine in the specifications of the patent, are in evidence to show to what extent success was attained. Enough is shown in the drawings and description to demonstrate that it corresponded more nearly to the form and mechanical arrangement of the first successful American productions of 1850 than did any of the several machines made during the intervening time. Knight says in his "Mechanical Dictionary": "The overhanging arm, vertically reciprocating needle, continuous thread, and automatic feed, were patented in England fifty years before Greenough's [machine] and sixty years before the Singer attained its excellence." This indicates that subsequent inventors from 1790 to 1850 either did not have knowledge of Saint's invention or did not choose to profit by it.

The first sewing-machine of official record that was put into operation is that of Barthlémy Thimonnier, patented in France in 1830. This machine was so far a success that in 1841, it is said, eighty of them were made, and used in making clothing for the French army, and were destroyed by a mob, as had been the Jacquard loom and other labor-saving machines years before. Thimonnier made another attempt in 1848 to introduce his machines in France, and a mob again defeated his efforts. He took out a patent in the United States, September 3, 1850, but his machine had no important features that were of value as compared with the sewing-machines of that date.

Several patents on sewing-machines were taken out in England and the United States up to the year 1846, but none of them contained the essential features necessary for success. September 10, 1846, Elias Howe, Jr., took out a patent in the United States on a machine that had new and important features, and that placed his name among the great inventors of this age of inventions. Prior to Howe all the sewing-machines patented made the chain or tambour stitch, or attempted to imitate sewing by hand, making what might be called the backstitch. They used a short thread with a common needle that was passed through the material and pulled out with pincers, or else a needle with an eye in the center, passing it through the material and making the same stitch as is common to workers in leather.

The chain-stitch was produced by Saint, Thimonnier, and others, and might properly be called a knitted stitch, as they used a continuous thread direct from the ordinary spool, and the stitch was formed the same as in knitting. Howe used an eye-pointed needle and a shuttle, passing the shuttle through a loop of the needle-thread and producing a lock-stitch alike on both sides of the material, with the lock or intertwining loops of the two threads pulled to the center; this might very appropriately be called a woven stitch in contradistinction to the chain or knitted stitch.

There is a general impression that Howe invented the eye-pointed needle, but this is not true. The

eye-pointed needle was invented many years before, and was extensively used in France for the purpose of working by hand, in a chain-stitch, the name of the manufacturer on the ends of broadcloths. It was also used in chain-stitch sewing-machines.

Howe's invention consisted of the combination of the eye-pointed needle with a shuttle for forming a stitch, and an intermittent feed for holding and carrying the material forward as each stitch is formed. The mechanical device for the feed was called the "baster-plate," and the length of the seam sewed at one operation was determined by the length of this plate. The material to be sewed was hung by pins to the "baster-plate" in an upright position, and if the seam to be sewed was of greater length than the plate it was necessary to rehang it on the plate, which was moved back to position in the same manner as a log is carried back and forth in a saw-mill.

It is not claimed that any machines made after the model of the original Howe machine were ever put into practical use. Mr. Howe, in his application for an extension of his patent, only claims to have made three machines, one being the model deposited in the United States Patent Office, and the other two he retained and claims to have used in sewing the seams for two suits of clothes, one for himself and the other for Mr. Fisher, the assignee of one half of the patent. Mr. Howe also relates that, not meeting with any success in obtaining adequate capital in this country, he sold the other half of his patent to his father for $1000, and went to England, where his right for a patent had been sold to William Thomas for £250. He engaged to work for Mr. Thomas at £3 per week in perfecting and adapting the machine for work in the corset factory of Mr. Thomas, in London. He was not successful in this, and was arrested for debt and took the "poor debtor's oath." Through the kindness of the captain of an American packet he was enabled to send his wife and children back to the United States. Later he took for himself steerage passage for Boston, where he found that sewing-machines had been made during his absence that infringed his patent. He then obtained a reconveyance of the half-interest previously conveyed to his father, and commenced suits to enforce his rights in Boston and New York. In the latter city he found I. M. Singer & Company making and selling machines, they setting up in the courts, in justification of their right to make machines, the claims of Walter Hunt, who established the fact that he made a sewing-machine with an eye-pointed needle and a shuttle that made the lock-stitch previous to the year 1834, but failed to apply for a patent on it or to produce a machine made at that time.

Mr. Howe further says that the suits brought by him in New York were fought with the utmost vigor and pertinacity by I. M. Singer & Company; but the courts decided that Hunt's invention was never completed in the sense of the patent law and did not in any way anticipate the patent granted to Howe. I. M. Singer & Company submitted to the decree of the court, and July 1, 1854, took out a license under the Howe patent, and paid him $15,000 in settlement of license on machines made and sold prior to that time. Howe then purchased the other half-interest of his patent, and his success in the Singer suit made it comparatively easy for the enforcement of his legal rights with others. He obtained an extension of his patent in 1860 for seven years, and again applied for another extension in 1867, setting up that he had received only $1,185,000, that his invention was of incalculable value to the public, and that he should receive at least $150,000,000 for it. His second application was very properly denied.

In 1853 Amasa B. Howe, an elder brother of Elias Howe, Jr., commenced the manufacture of sewing-machines under a license from his brother Elias, in which he infringed the Bachelder, Wilson, and Singer patents. Under subsequent arrangements he obtained the right to use those patents, and the machines were called the "Howe sewing-machine." This gave an erroneous impression to the general public as to what was really the original Howe sewing-machine. The facts in regard to it came out in after years, when Elias Howe, Jr., made an attempt to manufacture sewing-machines that were very like those made by Amasa B. Howe, and endeavored to appropriate the name of Howe as a trade name for the machines he manufactured. A suit brought by Amasa to establish his right to the word "Howe" as a trade name proved successful, the decision of the court being that Amasa B. Howe was the original inventor and proprietor of the trade-mark of "Howe" as applied to sewing-machines.

The next invention patented that covers a fundamental and important feature was that of John Bachelder, patented May 8, 1849. Bachelder's machine was the first to embody the horizontal table with a continuous feeding device that would sew any length of seam. His invention consisted of an endless leather belt set with small steel points projecting up through the horizontal table and penetrating the material to be sewed, carrying it along intermittently at a proper time to meet the action of the needle.

To Allen B. Wilson must be awarded the highest

meed of praise as an inventor, and for the ingenuity displayed in constructing and improving the sewing-machine. His patent of November 12, 1850, covered the invention of the moving feed-bar, with teeth projecting up through the horizontal table or plate of the machine, in conjunction with a presser-foot coming down on the material to be sewed, and holding it in position for the action of the feed-bar. His patents of August 12, 1851, and June 15, 1852, for improvement in a feeding device, and for a revolving hook for passing the upper thread around the bobbin containing the under thread, gave to the world a feed that would admit the sewing of a curved seam, which has become almost universal in the sewing-machine, while the revolving hook is a marvelous piece of ingenuity and mechanical skill.

It is to be regretted that Wilson did not receive an adequate reward for his great inventions. In his petition to Congress in 1874 for a second extension of the three above-named patents he stated that he did not receive anything above his expenses during the fourteen-year term of his original patent; that owing to his impecunious condition he was obliged to sell a half-interest for $200; that for the seven-year term of the extension he had only received $137,000; and that he had no stock or interest in any company manufacturing sewing-machines at that date; which statements were verified by his original partner.

The sewing-machine constructed by Allen B. Wilson was small and light, and only adapted for domestic purposes in the ordinary sewing for a family, or on very light fabrics in manufacturing. It used a vibratory arm for carrying the eye-pointed needle, which was curved to meet the arc of the circle described by the motion of the arm.

In 1873 the Wheeler & Wilson Manufacturing Company produced its first machine, with horizontal bed and overhanging arm attached thereto, using a needle-bar with perpendicular action and carrying a straight needle. Its vibratory arm was actuated by a cylinder-cam on the shaft under the table of the machine. This defective and cumbersome mechanism was not a success and was superseded by a rock-shaft in the overhanging arm. This was again displaced by substituting the revolving shaft, as used in the original Singer machine, and giving motion to the needle-bar and the upper thread "take-up" in the same manner as applied on the Singer machines at the present day.

In 1850 Mr. Isaac M. Singer visited Boston for the purpose of promoting the manufacture of a machine that he had invented for carving wood. His attention was there called to a sewing-machine made by Blodgett & Lerow, after the model of the Howe machine. That night he worked out in his mind a machine differing materially in shape, form, and mechanical construction, and made a rough draft of his conception, showing its advantages over the plan of construction of the first and only sewing-machine he had ever seen or heard of.

The feasibility of his plans being apparent to Mr. Orson C. Phelps, the owner of the machine-shop, and to Mr. George B. Zieber, who had previously been interested in the machine for carving, an agreement was entered into by which Singer was to furnish the plans, Phelps to do the work in his shop, and Zieber to put in $40 in money to pay for materials and expenses. It is a matter of well-authenticated history that the first machine was made in eleven days, and that "it went to work at once," and was the most perfectly organized sewing-machine for practical use that had been made up to that time.

Thus was created a sewing-machine that in its size and the mechanical construction of its arm and table serves as model for ninety-five per cent. of all the sewing-machines that are being made throughout the world to-day. It had the horizontal table, with a continuous feeding device coming up through an aperture in the table; an overhanging arm attached to the table; a horizontal shaft in the arm giving motion to a needle-bar acting perpendicularly and carrying a straight eye-pointed needle; a horizontal shaft under the table of the machine, and directly connected with and driven by the upper shaft, giving proper motion for moving the shuttle back and forward, and an intermittent motion to the feed-wheel, which was an improvement over the Bachelder feed, as it was constructed of iron, with a corrugated surface that did not penetrate the fabric or injure its surface. It also had a presser-foot to hold the fabric down to the feed-wheel, which had a yielding spring that would permit of passage over seams, or would sew different thicknesses without requiring any change in its adjustment. This important feature had not been shown in any other machine up to that time. The yielding spring presser-foot was claimed by Mr. Singer in his original application for a patent on a sewing-machine; but this claim was disallowed because there was a question as to who was the first to invent this important feature, although the idea was undoubtedly original with Singer.

The construction of the original Singer machine, with its straight horizontal shaft in the overhanging arm, easily admitted enlargement and extension, thus gaining increased space for handling the work.

As an indication of its capabilities in this respect it may be stated that at this time there are over forty distinct classes of machines made by The Singer Manufacturing Company, that vary in size and capacity from the smallest for domestic purposes to a machine having a bed eighteen feet in length and capable of stitching canvas belting of any practicable width and up to one and one half inches in thickness. Mr. Singer did not confine his efforts to his original machine and the lock-stitch, but in 1854 he invented a "latch underneedle," and constructed a machine making the single-thread chain-stitch; and the same year he produced a machine for embroidering, using two threads and making a double-thread chain-stitch, with a very ingenious mechanism for throwing another thread back and forth in front of the needle and producing an ornamental fringe.

In 1856 he brought out a machine making the lock-stitch, but discarded the wheel-feed and used the "Wilson four-motion feed"; so that the name of Singer, as applied to sewing-machines, did not designate any particular type of machine, or a machine making any one kind of stitch, or using either of the well-known feeding devices. He also turned his attention to making attachments for the sewing-machine, in the way of binders, rufflers, etc.

The machines of prior date to Singer, and many of them for a long time after, used either a vibratory arm and a curved needle or a vibratory arm and a needle-bar carrying a straight needle. It is obvious that a machine constructed on either of these principles could not be enlarged without destroying its effectiveness. The shorter the arm, the greater the curve of the needle, and the more contracted the space for turning and handling the work; the longer the arm, the more liability to spring and affect the proper action of the needle, and the more power required to propel the machine and drive the needle through the material to be sewed.

We have now reached a period where the inventors had discovered the essential features of a sewing-machine and made them mechanically practicable. The time had arrived for active and practical business men to take hold of it and make the discovery of value to the world at large. A new industry had sprung into existence, the product of which was not only to be of great importance in itself, but was also to work a revolution in many branches of manufacturing industry.

The men who came to the front and duly appreciated the magnitude of the prospective business were Mr. Nathaniel Wheeler of the Wheeler & Wilson Company, Mr. Orlando B. Potter of the Grover & Baker Company, and Mr. Edward Clark of I. M. Singer & Company. Mr. Nathaniel Wheeler became a partner of Allen B. Wilson in 1851. Mr. Wheeler brought with him energy and ambition that soon developed into superior business ability. This, with fine presence and engaging manners, enabled him to obtain financial aid from some of the leading capitalists of Connecticut, his native State. His great tact in the way of bringing before the public, by advertisements and otherwise, the fact that sewing by machinery could be practically accomplished in the household gave the invention of Wilson an enormous sale, and its manufacture at Bridgeport, Conn., soon became one of the most important manufacturing industries in that city.

Mr. Wheeler became prominent in banking and other business interests, and received political honors from both city and State. He was president and general manager of the Wheeler & Wilson Manufacturing Company from its organization down to the date of his decease, in January, 1894.

Mr. Orlando B. Potter was president of the Grover & Baker Sewing-Machine Company, a corporation organized under the laws of Massachusetts, with its factory located at Boston. Mr. Potter, however, recognized the fact that New York was the metropolis, and the proper place for him to establish himself and the headquarters of his company.

The inventions of William O. Grover and William E. Baker were of prime importance in some of the sewing-machines of early date, but the great feature was the "Grover & Baker stitch." It was formed by interlocking the upper and lower threads on the under side of the material, and producing on the knitting principle a double chain-stitch. This company also made a few machines using a shuttle and making the regular lock-stitch; but Mr. Potter became imbued with the belief that the Grover & Baker stitch would be the stitch universally used in family sewing and nearly every branch of manufacture, and he apparently directed his efforts to that end. That he had committed an error became evident, as the sales of the Grover & Baker machines decreased, while those making the lock-stitch were increasing in much greater proportion.

In 1875 Mr. Potter sold out the business and all the effects of the Grover & Baker Sewing-Machine Company to a company making lock-stitch sewing-machines. The demand for the Grover & Baker machines became so small that their manufacture soon ceased, and the name of the Grover & Baker machine and stitch soon passed out of existence.

The merits of a double chain-stitch are in its elasticity, and in using the under thread direct from the commercial spool without rewinding. Machines making a similar stitch have been made since that time for use in the manufacture of knit goods, bags, etc., where an elastic seam is required, and the stitch is also used in machines made by the Singer Company for sewing the seams in carpets.

After Mr. Potter's graceful retirement from the sewing-machine business he showed his faith in the progress and growth of his adopted city, New York, by large investments in real estate. He became interested in politics, being twice elected to Congress, where he was very prominent and an important member of some of its leading committees.

The complex and important litigation of the early days of the sewing-machine required the employment of the very best legal talent of that period; and soon after the establishment of the business of I. M. Singer & Company in New York, in the early part of 1851, they employed Messrs. Jordan & Clark as their attorneys and counselors. The senior member of that firm, Ambrose L. Jordan, was at that time attorney-general of the State of New York, and the affairs of that office so engrossed his attention that the junior partner, Edward Clark, took in charge the new clients. They were unable to pay the fees and costs of the extensive litigation in which they were involved, and Mr. Clark accepted an interest in the firm to secure payment for his services and the advances he had made. Mr. Singer recognized the legal ability and business sagacity of Mr. Clark, and proposed that they should buy out the interest of the other partners, Mr. Clark taking charge of the legal and financial branch of the business, while Mr. Singer gave his attention to the manufacturing and improving of the sewing-machine. In March, 1852, they consummated this arrangement; and from that time up to the incorporation of The Singer Manufacturing Company, in April, 1863, Mr. Clark had charge of the financial and commercial branch of the business, and directed the affairs in litigation. That he conducted both of these important parts of the business with success is well attested by the remarkable growth of the first and the well-protected interest of the latter.

Mr. Clark at an early day appears to have fully comprehended the value of the sewing-machine as an article of trade and commerce. His policy always contemplated the diffusion of the business in every direction, following the most direct method of placing its products in the hands of the consumer. He not only established agencies throughout the United States, which were conducted by agents employed under salaries, but he gradually extended a system of agencies throughout Europe and all other parts of the civilized world. In 1856 he originated and inaugurated the system of selling sewing-machines on the renting or instalment plan, and this method has been adopted and extended throughout the offices of the company all over the world. This system has been extended by others to the sale of nearly every article of merchandise, from a family Bible to a railway-car, and has proved of inestimable benefit to mankind.

Mr. Clark continued to take an active interest in the business of The Singer Manufacturing Company, holding the office of president of the company from 1876 down to the day of his decease, in 1882. He was a large owner of real estate in the city of New York, being one of the first to construct a building for residences on the French system. Among the notable buildings of this class erected by him are the "Dakota" and the "Van Corlear."

Mr. Clark was of a very modest and retiring disposition, and never permitted himself to be brought prominently before the public; and although he was at the head of one of the largest mercantile enterprises in the world, his natural tendency for association was with the members of his profession. If occasion called he had an easy flow of rhetoric, and with a pen his diction was pure, terse, and to the point. These qualities, with clear logical reasoning on legal questions, and an inherent love of equity, would have insured him high standing had he continued in active practice at the bar, or he would have graced with ornate dignity the bench of a court of last resort.

After the validity of the patent of Elias Howe, Jr., had been fully established, he commenced a system of licenses to manufacturers of sewing-machines, demanding the exorbitant price of $25 on each machine, without any regard to its merits. In his application for a second extension of his patent he states that his first license was granted May 18, 1853, and that up to July, 1854, he had granted fifteen licenses "for the general manufacture and sale of sewing-machines." As Howe's imperfect and impractical models did not contain the features essential to practical sewing-machines, the result of operation under his licenses was suits and counter-suits by the owners of the more important patents, and great distrust and unrest on the part of all purchasers of sewing-machines.

In 1856 the owners and controllers of the Bachelder, Wilson, and other fundamental patents brought about a coalition, in which they included

Elias Howe, the Wheeler & Wilson Manufacturing Company, the Grover & Baker Sewing-Machine Company, and I. M. Singer & Company; thus forming the famous "sewing-machine combination" in which were pooled all the patents of the essential features of the sewing-machine in such a way as to protect the interest of each of its members in an equitable manner, and enable other manufacturers to continue in the business by the payment of only one license-fee to the combination. Under this arrangement any manufacturer who had a meritorious machine that was not an offensive imitation of the machine of some other licensed manufacturer was granted a license, the rate being uniform to all, and much less than the excessive and exorbitant license previously demanded by Elias Howe, Jr.

There was no pooling of any other interest in the combination excepting that of the patents; no restrictions were placed on the price at which the machines were to be sold, either at wholesale or retail, but the market was open to fair competition on the merits of the several machines, and the result was to be the "survival of the fittest." The combination continued in existence with Mr. Howe as a member until the expiration of the extended term of his patent in 1867, and was then continued by the other members in interest until the expiration of the Bachelder patent in 1877.

No record or estimate was made as to the number of sewing-machines manufactured prior to the date when Howe began to grant licenses, but from that time to the termination of the combination a report was made at stated periods by all licensed manufacturers. Unfortunately some of the records of the combination were destroyed by fire, and only a partial list, showing the number of machines made from 1853 to 1877 by each of the several manufacturers, can be furnished. Enough, however, is shown in the tabular statement appended to indicate the volume of business from year to year during that period.

A PARTIAL STATEMENT FROM RECORDS OF "THE SEWING-MACHINE COMBINATION," SHOWING NUMBER OF SEWING-MACHINES LICENSED ANNUALLY UNDER THE *ELIAS HOWE* PATENT.

Name of Manufacturer.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.	1864.	1865.	1866.
Wheeler & Wilson Mfg. Co.	799	756	1,171	2,210	4,591	7,978	21,306	25,102	18,556	28,202	29,778	40,062	39,157	50,132
I. M. Singer & Co.	810	879	883	2,564	3,630	3,594	10,953	13,000 (a)	16,000 (a)	18,396	...	...	...	...
The Singer Manufacturing Co.	...	...	...	...	...	...	...	...	...	...	20,030	23,632	26,340	30,960
Grover & Baker S. M. Co.	657	2,034	1,144	1,952	3,680	5,070	10,280	(b)	(b)	(b)	(b)	(b)	(b)	(b)
A. B. Howe " "	...	60	53	47	133	179	921	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Leavitt " "	28	217	152	235	195	75	213	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Ladd & Webster " "	100	268	73	180	453	490	1,788	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Bartholf " "	135	55	31	35	31	203	747	(b)	(b)	(b)	(b)	(b)	(b)	(b)

A PARTIAL STATEMENT SHOWING NUMBER OF SEWING-MACHINES LICENSED ANNUALLY FROM 1867 TO 1876 INCLUSIVE.

Name of Manufacturer.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.
The Singer Manufacturing Company	43,053	59,629	86,781	127,833	181,260	219,758	232,444	241,679	249,852	262,316
Wheeler & Wilson Mfg. Company	38,055	(b)	78,866	83,208	128,526	174,088	119,190	92,827	103,740	108,997
Grover & Baker Sewing-Machine Co.	32,999	35,000 (a)	35,188	57,402	50,838	52,010	36,179	20,000 (a)	15,000 (a)	...
Weed Sewing-Machine Co.	3,638	12,000	19,687	35,002	39,655	42,444	21,769	20,495	21,993	14,425
Howe Sewing-Machine Co.	11,053	35,000 (a)	45,000 (a)	75,156	134,010	145,000 (a)	90,000 (a)	35,000 (a)	25,000 (a)	109,294
A. B. Howe " "	...	...	...	...	20,051	...	...	...	...	...
B. P. Howe " "	...	...	...	...	...	14,907	13,919	...	...	...
Willcox & Gibbs Sewing-Machine Co.	14,152	15,000	17,201	28,890	30,127	33,639	15,881	13,710	14,522	12,758
Wilson (W. G.) " "	...	...	...	...	21,153	22,666	21,247	17,525	9,508	...
American B. H. & S. M. Co.	...	...	7,792	14,573	20,121	18,930	14,182	13,529	14,406	17,937
Florence S. M. Co.	10,534	12,000	13,661	17,660	15,947	15,793	8,960	5,517	4,892	2,978
Shaw & Clark Sewing-Machine Co.	2,692	3,000	...	...	...	...	...	...	...	...
Gold Medal " " "	...	...	...	8,912	13,562	18,897	16,431	15,214	14,262	7,185
Davis " " "	...	...	...	...	11,568	11,376	8,861	...	...	...
Domestic " " "	...	...	...	...	10,397	49,554	40,114	22,700	21,452	23,587
Finkle & Lyon Mfg. Co. and Victor	2,488	2,000	1,339	2,420	7,639	11,901	7,446	6,292	6,103	5,750
Ætna Sewing-Machine Co.	2,958	3,500	4,548	5,806	4,720	4,262	3,081	1,866	1,447	707
Blees " " "	...	...	...	...	4,557	6,053	3,458	...	...	...
Elliptic " " "	3,185	...	...	...	4,555	...	...	...	...	...
Empire " " "	2,121	5,000	8,700	...	...	...	...	...	...	...
Remington Sewing-Machine Co.	...	...	...	3,560	2,965	4,982	9,183	17,608	25,110	12,716
Parham " " "	...	...	1,141	1,766	2,056	...	...	...	...	...
Bartram & Fanton Mfg. Co.	2,958	...	...	...	1,004	1,000	1,000	250	...	...
Bartlett Sewing-Machine Co.	...	...	...	...	614	1,000	...	...	...	...
J. G. Folsom	...	...	...	...	280	...	...	...	...	...
McKay Sewing-Machine Asso.	...	...	...	129	218	...	...	128	161	102
C. F. Thompson	...	...	...	...	147	...	...	...	...	...
Union Buttonhole Machine Co.		...	...	...	124	...	...	...	...	...
Leavitt Sewing-Machine Co	1,051	1,000	771	...	...	...	...	...	...	...
Goodspeed & Wyman S. M. Co	2,126	...	...	...	...	...	...	...	...	...
Keystone Sewing-Machine Co.	...	...	...	...	...	2,665	217	37	...	...
Secor " " "	...	...	...	...	...	311	3,430	4,541	1,307	...
Centennial " " "	...	...	...	...	...	...	514	...	...	...

(a) Number estimated. (b) No data.

From the beginning to the end of the combination there was an army of would-be infringers and imitators who kept up a constant howl on any and all occasions, claiming that the existence of the combination tended to retard the improvement of the sewing-machine, and that the public were the sufferers thereby. It is now nearly twenty years since the expiration of the last important patent on a fundamental principle of the sewing-machine, and it is a notable fact that two of the companies that were members of and formed the combination in 1856 are the only manufacturers, with one or two exceptions, that have shown any marked improvement in the sewing-machine proper over those of twenty-five years ago, or who now produce machines that are capable of being run by steam or other power at the high rate of speed, and doing the grade of work, that is required in the factory use of sewing-machines at the present day.

It may be said that the patents issued to Howe, Bachelder, and Wilson cover all the fundamental principles of the sewing-machine. If we divide the various machines into two classes, the "dry thread" and the "wax thread," it appears that the number of patents covering all the essential elements in the first-named class do not exceed ten, and an equal number those in the other. Reference will be made later to important inventions in machines using wax thread, and only employed on leather in the manufacture of boots and shoes, harness, etc.

The inventive genius of the age is actively engaged in the production of new developments of the sewing-machine, and patents covering devices of more or less utility are constantly being granted. The annexed list shows the number of patents issued by the United States for sewing-machines and accessories, from the first to J. J. Greenough, dated February 21, 1842, down to September 10, 1895, the total being 7439. Of this number there were:

Sewing-machines making the chain-stitch	433
Sewing-machines making the lock-stitch	661
Sewing-machines for stitching leather	431
Feeding devices for sewing-machines	316
Machines for working buttonholes	448
Machines for sewing on buttons	33
Miscellaneous parts of sewing-machines	2,950
Attachments, rufflers, hemmers, corders, etc	1,524
Cabinet cases and tables	473
Motors: foot, hand, steam, air, and electric	170

This classification is a continuation in part of the system adopted and used in Knight's "Mechanical Dictionary," comprising patents on sewing-machines issued up to March 10, 1875. It is not a complete or accurate classification, as it enumerates each patent only once, classifying it according to its most important feature, although it may cover several other minor features of the sewing-machine which may have been embodied in the same patent. For instance, the original Howe patent covers the combination of the eye-pointed needle and the shuttle for forming the stitch, and also the very important device for feeding the material to meet the proper action of the needle and shuttle; yet it is entered in the list but once, and then simply as a sewing-machine making the lock-stitch.

DESCRIPTIVE LIST OF EARLY U. S. PATENTS ON SEWING-MACHINES FROM 1842 TO 1855.

Serial Number.	Date.	Name.	Invention.
			1842.
2,466	Feb. 21	J. J. Greenough	Using short thread. Needle with eye in center, pointed at both ends, pulled through the material with pincers, and making shoemaker's stitch.
			1843.
2,982	March 4	B. W. Bean	Short thread, running stitch, ordinary hand-needle, cloth crimped into ridges for passage over the needle.
3,389		G. H. Corliss	"Sewing Engine." Short thread. Similar to Greenough's.
			1844.
3,672	July 22	J. Rodgers	Running stitch. Similar to Bean's.
			1846.
4,750	Sept. 10	Elias Howe, Jr.	*Eye-pointed needle in combination with shuttle for under thread, continuous thread from spools, lock-stitch, automatic feed the length of baster-plate.*
			1848.
5,942	Nov. 28	J. A. Bradshaw	Lock-stitch, reciprocating shuttle.
			1849.
6,099	Feb. 6	C. Morey & J. B. Johnson	Chain-stitch, *barbed needle.*
6,437	May 8	J. S. Conant	Chain-stitch.
6,439	May 8	J. Bachelder	*Two or more threads, chain-stitch, continuous feeding device, horizontal table, and overhanging arm.*
6,766	Oct. 2	S. C. Blodgett & J. A. Lerow	Lock-stitch, shuttle rotating in a lateral annular race. Continuous feed by endless rotating baster-plate.

DESCRIPTIVE LIST OF EARLY U. S. PATENTS ON SEWING-MACHINES.—*Continued.*

Serial Number.	Date.	Name.	Invention.
			1850.
7,296	April 16	D. M. Smith	Running stitch, short thread.
7,369	May 14	O. L. Reynolds	Chain-stitch.
7,622	Sept. 3	B. Thimonnier, Sr.	Chain-stitch.
7,659	Sept. 24	J. Bachelder	Chain-stitch.
7,776	Nov. 12	A. B. Wilson	*Lock-stitch, vibratory shuttle pointed at both ends, reciprocating feed-bar.*
7,824	Dec. 10	F. R. Robinson	Short thread.
			1851.
7,931	Feb. 11	W. O. Grover & W. E. Baker	*Chain-stitch, two or more threads.*
8,282	Aug. 5	W. H. Akins & J. D. Felthousen	Lock-stitch.
8,294	Aug. 12	I. M. Singer	Lock-stitch, *feed-wheel, thread controller.*
8,296	Aug. 12	A. B. Wilson	Lock-stitch, *rotary hook, for carrying upper thread around bobbin containing under thread.*
			1852.
8,876	April 13	I. M. Singer	Lock-stitch, thread controller, and tension device.
9,041	June 15	A. B. Wilson	Lock-stitch, rotary hook. *Four-motion feeding bar.*
9,053	June 22	W. O. Grover & W. E. Baker	Chain-stitch, two threads.
9,139	July 20	C. Miller	Back-stitch, vibratory shuttle.
9,338	Oct. 19	O. Avery	Chain-stitch, two needles, two threads.
9,365	Nov. 2	C. Hodgkins	Chain-stitch, two needles, two threads.
9,380	Nov. 2	J. G. Bradeen	Short thread, running stitch.
			1853.
9,556	Jan. 25	F. Palmer	Feeding device.
9,592	Feb. 22	W. H. Johnson	Chain-stitch, two needles, two threads.
9,641	March 29	T. C. Thompson	Lock-stitch, magnetic shuttle and race for keeping shuttle in contact with race.
9,665	April 12	W. H. Johnson	Cloth holder and feeding device.
9,679	April 19	W. Wickersham	Sewing leather, barbed needle, two threads.
10,344	Dec. 20	H. L. Sweet	*Binder*, for binding hats, etc.
10,354	Dec. 20	S. C. Blodgett	Chain-stitch, two needles, two threads.
			1854.
10,386	Jan. 3	S. C. Blodgett	*Hemmer*, for sewing umbrellas.
10,597	March 7	W. H. Johnson	Chain-stitch, one thread, *needle feed.*
10,609	March 7	C. Miller	*Buttonhole*, two threads.
10,615	March 7	W. Wickersham	Sewing leather, chain-stitch, *two needles, two parallel rows of stitching.*
10,622	March 7	C. Hodgkins	Chain-stitch, two threads.
10,728	April 4	W. H. Akins	*Cop for shuttle.*
10,757	April 11	S. J. Parker	Lock-stitch, *transverse reciprocating shuttle.*
10,763	April 11	J. Harrison, Jr.	Lock-stitch, reciprocating shuttle. Upper and under thread controller.
10,842	May 2	I. M. Singer	Chain-stitch, two threads; *embroidery attachment carrying third thread.*
10,875	May 9	S. Coon	Lock-stitch; reciprocating shuttle, thread controller.
10,878	May 9	H. Crosby, Jr.	Lock-stitch; revolving hook, thread controller.
10,879	May 9	C. Hodgkins	Feed-wheel movement.
10,880	May 9	O. Avery	Chain-stitch, two needles, and two threads.
10,974	May 30	I. M. Singer	Chain-stitch, one thread; latch underneedle, *lifting presser foot.*
10,975	May 31	I. M. Singer	Lock-stitch, shuttle-thread controller and tension.
10,994	May 31	M. W. Stevens & E. G. Kinsley	Lock-stitch, *reciprocating shuttle in cylinder bed, with feed-wheel.*
11,161	June 27	Walter Hunt	Lock-stitch, reciprocating shuttle. Needle feed.
11,240	July 4	W. Butterfield	Chain-stitch, waxed thread for leather. Barbed needle, wheel feed.
11,284	July 11	G. A. Leighton	Chain-stitch, two threads.
11,507	Aug. 8	A. Swingle	Sewing leather, chain-stitch, one thread.
11,531	Aug. 15	S. H. Roper	Short thread, backstitch.
11,571	Aug. 22	E. Shaw	Sewing leather.
11,581	Aug. 22	M. Shaw	Sewing leather. Clamp-guides.
11,588	Aug. 22	S. S. Turner	Sewing leather. Single thread, chain-stitch.
11,615	Aug. 29	J. B. Nichols	Binder and folder.
11,631	Aug. 29	S. S. Turner	Sewing leather, wheel-feeding device.
11,680	Sept. 12	P. Shaw	Wheel-feeding device.
11,884	Nov. 7	D. C. Ambler	Lock-stitch, two needles, *overseaming for felling lap-seams.*
11,934	Nov. 14	D. Harris	Lock-stitch, upper-thread controller.
11,971	Nov. 21	C. Parham	Lock-stitch, *shuttle carrier.*
12,011	Nov. 28	T. E. Weed	Thread controller.
12,014	Nov. 28	O. G. Boynton	Binder.
12,015	Nov. 28	T. J. W. Robertson	Lock-stitch, stationary shuttle.
12,066	Dec. 12	W. Lyon	Feeding device.
12,074	Dec. 12	G. W. Stedman	Chain-stitch.
12,116	Dec. 19	A. B. Wilson	Feeding device.

CONDENSED CHRONOLOGICAL LIST OF U. S. PATENTS ISSUED FROM 1842 TO SEPTEMBER 10, 1895, ON SEWING-MACHINES AND ACCESSORIES THERETO.

1842 to 1855	As per preceding list	70
1855 to 1867	Expiration of Howe's patent	843
1867 to 1877	End of sewing-machine combination and expiration of Bachelder patent	2,144
1877 to 1887		2,496
1887 to Sept. 10, 1895		1,886
Total		7,439

The large number of patents indicates that inventors have not been idle or neglected the sewing-machine. But there is something required aside from the mere invention. The inception of the original idea is only the first essential; it is equally necessary to have the place and opportunity to experiment, and to get the machine into practical operation and test it on the class of work it is required to do.

In the larger factories of the present time the experimental department is one of the most important and expensive. Here the inventor's idea is carefully wrought into form and receives preliminary tests of its efficiency. After carrying it to what seems to be a perfect condition, involving months, and sometimes years, of patient toil and disappointment, the machine or attachment is then sent to various factories engaged in the class of work for which it is intended, and there it is put to the severest tests of practical use. If its operation appears to be satisfactory, then a special plant of machinery is installed to make this new machine, attachment, or part, so that it can be perfectly duplicated in any number required. After all this expensive preparation and experiment, the invention may soon be replaced by something better and be abandoned. Notable instances of this are shown in the development of the Goodyear machine for stitching soles to shoes. It was a matter of several years of devoted labor before the inventors succeeded in getting this machine to perform satisfactory work, and within the past year improvements have been made that render a change from the old to the new machines desirable.

The same can be said of the latest production of the Singer Company for sewing breadths of carpet together. The older machine is propelled by hand-power, and the operator walks along by the side of the distended breadths, working the machine, and using some skill and labor in getting the carpet properly matched and stretched. The new machine is operated by mechanical power, and is constructed so as to hold the carpet in position by means of clamps, that also assist in matching the figures properly, and then stretch it so that it will lay perfectly flat on the floor after it is sewed. The little sewing-machine, which passes along on a track in proper position to do the sewing, is propelled by electric or other power. It starts and stops by means of automatic devices that work in conjunction with the clamps that match and hold the carpet in position. When it arrives at the end of the seam it unlocks itself from the forward motor-power and grasps another, that takes it quickly back to place of beginning. The production of the hand-machine is equal to that of eight or ten hand-sewers; but the new power-machine has a capacity eight or ten times greater than the hand-machine, and one operator can handle the increased quantity of carpet with greater ease and less labor. There is no royalty on the product of this machine, but it is sold outright, as are all machines made by the Singer Company.

Under the title of "motor" are classed devices for driving a sewing-machine by hand and foot power, and engines to be attached to the machine and propelled by water, steam, air, and electricity. The sewing-machines prior to Singer had no arrangement for applying power for driving them except the common hand-crank. This required the use of the right hand, and only the left hand could be used for arranging and guiding the material to be sewed. The machines were put on a bench or table of home construction. Singer, in traveling about exhibiting his original machine, utilized the box in which it was packed for shipment as a table, and conceived the idea of using a treadle similar to that employed on the old spinning-wheel, and having a pitman attached to the handle on the driving-gear to assist him in working the machine. He used an ordinary door-hinge as a fulcrum for the treadle, which was longer than the depth of the box, and projected therefrom. He therefore placed the hinge about where the instep of the foot would be, and attached the other half of the hinge to the box, and thus found that he had a rocking motion on the treadle that aided in securing uniform motion to the machine. He soon discovered that, with the addition of a balance-wheel on the upper shaft for increasing the momentum when the machine was once in motion, he could run it by foot-power with his rocking treadle, operated by heel-and-toe motion, and so have the use of both

hands for guiding and arranging the material. This was a great gain in utilizing the machine, and he soon after produced an iron stand having a rocking treadle constructed for the use of both feet. Mr. Singer did not realize that he had made a great and important discovery, and failed to apply for a patent. He was very much chagrined after having used the invention for two years and thus debarring himself from a patent, to be informed of his oversight by a rival manufacturer.

Many devices have been made for driving the sewing-machine by foot-power since that time, the latest being the revolving treadle with the bicycle movement; but none of them have been as good as the rocking treadle. Backus, in 1874, made a water-motor that had some sale; Ericsson made an air-engine in the same year; and a number of small steam-engines and a great many devices using springs, weights, etc., have been tried, but no efficient motor has been successfully put on the market until the development of the use of electricity for power. The "Diehl electric sewing-machine motor" can be directly connected to the main shaft of a sewing-machine, and is a great success on account of its convenience, compactness, and effectiveness. In its smallest form, for driving individual machines, the field-magnet is secured to the arm of the machine, the armature being carried inside a brass wheel which acts as a balance-wheel. The rheostat is attached to the ordinary foot-power table or cabinet case, and is connected by a pitman with the treadle, so that the machine may be started and stopped and the speed regulated as desired by pressing the foot on the treadle. The versatile inventor of this motor has made a notable demonstration of the uses of electricity by applying it to the operation of a sewing-machine drop-cabinet and its contents for the purpose of public exhibition. The cabinet stood in a show-window on Broadway, and, apparently of its own volition, the cover of the case opened, the sewing-machine was elevated from its receptacle under the table, the doors to this receptacle were folded back, and the machine began operation at a high rate of speed. After a few minutes this operation ceased, the machine descended to its former position, the cabinet was fully closed, and became an elegant and useful table, appropriate to the most ornate furnishings.

For the factory operation of sewing-machines there are ingenious devices for their stable support on tables which are made in sections, carrying the shafting, and so arranged as to be readily connected in longer lengths as desired, and adjustable to any unevenness of floor. These tables are made for the operation of one or of two rows of machines from one line of shafting, which is so carried beneath the tables that it is easily adjusted. The tables have a thick wooden top that may be entirely flat, or it can be provided with convenient work-holding troughs. In point of convenience, cleanliness, safety, and economy these tables leave nothing to be desired, for they seem to satisfy all requirements in these respects. In the matter of power transmission from the shaft to the machine there are several devices to enable the instant stopping and starting of the machines. The use of electricity has demonstrated the feasibility of attaching the electric motor directly to a shaft for transmitting power at the point where it is needed. Much economy is gained by this method over the old system of successive countershafting and belting, with its dangers, its expense, and the loss of efficiency. The ideal system will have been reached when the motor is attached to the head of each sewing-machine, so that all objects intervening between the source and the subject of power, other than the wire for the electric current, can be dispensed with.

The reports to "the sewing-machine combination" of the sales of sewing-machines during the four years 1873–76 show a total of 2,303,941, the average for each year being about 576,000. As these reports terminated with the year 1876, we have no other information as to the extent of sewing-machine manufacture since that time than what is indicated by the United States census reports of 1880 and 1890. The total value of production reported at the census of 1880 for one year was $13,863,188, the census of 1890 showing a value of $12,823,147. These figures indicate that the average number of machines made annually during the last twenty years has been from 500,000 to 600,000.

A comparison of the census reports of 1880 and 1890 shows a decrease of fifty per cent. in the number of establishments engaged in the manufacture of sewing-machines, but also shows that the number of persons employed was about the same, and that their average wages increased about ten per cent. during the decade. In 1880 the average wages were $485, and in 1890 they were $567 per annum, thus showing the class of labor employed to be of a very high order. The reports, at the census of 1890, from fifty-six establishments showed the employment of 9121 operatives, whose wages amounted to $5,170,555. The market value of their product was $12,823,147, so that the cost of their labor constituted forty per cent. of this value.

The table on pp. 536 and 537, relating to exports of sewing-machines, shows the value of such exports to have exceeded $67,000,000 during thirty years, 1865–95, the annual average during the last ten years exceeding $2,500,000. This sum does not, however, adequately represent the foreign use of the American sewing-machine, because American establishments are extensively engaged in the manufacture of these machines in other countries. An active foreign demand for the American sewing-machine was developed during the Civil War, 1861–65, and the value of machines exported during the year ending June 30, 1865, was nearly $2,000,000. The foreign selling-price per machine was less than the domestic price, but the high premium on foreign exchange and the depreciated United States currency made the business fairly remunerative at that time. As previously stated, the cost of labor in the manufacture of a sewing-machine is forty per cent. of its total cost at the present time; but during the period from 1861 to 1865 wages did not increase as fast as the value of the currency decreased, and thus the machine could be sold at a price in specie very much below its value in United States currency.

Upon the gradual restoration of that currency to its normal specie value, however, the rates of wages were not reduced to correspond to their increased purchasing power; on the contrary, these rates have steadily increased, as has been shown. Thus the cost of the domestic manufacture became too high to enable competition in the world's markets with the numerous imitators who were manufacturing in Great Britain and on the continent of Europe. Therefore some of the American manufacturers established factories in foreign countries, and supplied them with American machinery and tools for producing facsimiles of the machines made by these manufacturers in the United States.

The "American system" of making all parts of the finished product completely interchangeable has been carried to its highest development in the manufacture of sewing-machines, every piece being made to gauge and tested before assembling. In no branch of manufacture has the use of automatic machines and tools of fine precision become more essential than in this. The special tools required to make the various parts of some of the many varieties of sewing-machines often require greater inventive talent and ingenuity than that displayed in the machine produced.

The Singer Company have continued the manufacture in foreign countries of duplicates of the machines made in this country; and the factories erected by this company at Kilbowie, near Glasgow, Scotland, are equal in capacity to the factories at Elizabethport, N. J., and have produced about 400,000 machines annually during the past four years. The total number of all the machines made by I. M. Singer & Company and their successors, The Singer Manufacturing Company, from 1853 to October 1, 1895, is 13,250,000, and of this number 5,877,000 have been made in factories located in foreign countries, but under the direct control and management of the American company.

The average value of the exports of sewing-machines, including cabinet-work and parts of sewing-machines, from the United States, indicates that about 150,000 machines are exported annually; and it is a fair estimate that the total number of American sewing-machines sold annually in foreign countries, including those made abroad, is equal to the sales in the United States by all the American companies.

The export of sewing-machine cabinet-work is a matter of considerable importance, because the United States easily surpasses all other countries in the wealth of its woods for this purpose, in the ingenuity of its cabinet-makers, and in the efficiency of its woodworking machinery. The different climatic conditions of other countries and continents do not admit of finishing the woodwork in this country; but it is cut "in shape" and exported "in the white," so that it can readily be put together and finished where it is to be used.

The number of tables and cabinet-cases for foot-power stands, and of cases for hand-machines, exported by the Singer Company aggregate about 694,000 annually; of this number the cases for hand-machines constitute about seventeen per cent. The proportion of hand to foot-power machines used in Europe and in Asiatic countries is far greater than in the United States, where the operation of a sewing-machine by hand is very exceptional, and usually confined to those crippled and physically unable to apply foot-power. The great difference in social conditions is largely accountable for this peculiarity, and the increased use of the hand-machine in Europe is also largely due to the itinerant character of the urban population, who find the tables and stands an impediment in their constant moving from house to house.

The most remarkable industrial development in connection with the sewing-machine has been its diversification and adaptation for use in a great variety of manufactures, which have thus been enabled to

VALUE OF AMERICAN SEWING-MACHINES EXPORTED.

COMPILED FROM STATISTICS OF THE UNITED STATES TREASURY.

NO DATA FOR THE YEAR 1866.

EXPORTED TO	1865.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.
	$	$	$	$	$	$	$	$	$	$	$	$	$	$
CONTINENTAL EUROPE:														
Austria Hungary	......	80	......	100	11,610	......	......	......	40	......	......	......	......	......
Belgium	5,754	9,102	......	8,107	8,228	6,400	100	......	......	19,800	8,723	8,951	10,416	17,67
France	55,961	138,437	107,781	185,234	148,059	10,623	133,915	72,886	53,086	92,111	57,230	38,281	41,135	59,98
Germany	465,425	362,244	377,710	706,709	516,303	277,013	456,640	330,199	214,965	462,264	367,369	587,684	539,187	563,91
Holland	628	133	......	......	330	359	100	6,588	134	330	854	1,131	605	2,81
Italy	20	604	150	150	159	......	......	52	400	50	280	1,284	1,881	83
Portugal	661	100	120	......	823	400	330	......	84	......	......	......	289	36
Russia	28,433	3,407	2,912	6,700	14,190	9,762	......	......	3,228	103	......	......	......	7,65
Spain	5,728	358	3,539	1,900	5,734	14,019	1,677	202	200	......	......	722	115	20
Sweden and Norway	135	......	......	......	......	......	......	......	......	......	......	......	......	5
Switzerland	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Turkey	......	......	......	50	139	1,509	......	......	180	287	......	......	......	9
GREAT BRITAIN	753,792	618,965	723,003	662,070	926,896	986,553	898,405	768,903	512,328	567,764	699,016	486,842	482,574	363,43
BRITISH NORTH AMFRICA	25,724	12,665	16,285	22,169	23,621	35,030	53,499	49,953	60,752	72,518	70,987	124,341	19,785	23,81
BRITISH AUSTRALASIA	135,626	91,758	57,763	120,776	149,144	59,869	97,406	176,295	140,524	82,480	103,154	77,632	110,221	118,67
WEST INDIES:														
British West Indies	7,295	1,743	1,094	2,182	2,906	3,845	5,620	7,500	8,617	7,414	9,507	5,393	3,084	4,23
Haiti	1,233	436	770	204	2,245	6,870	3,175	3,443	410	1,137	3,556	4,616	5,007	1,25
Santo Domingo	1,805	90	72	......	......	......	3,884	4,715	2,040	3,294	4,238	1,283	2,901	2,89
Cuba	94,213	80,659	49,042	22,049	37,633	66,969	71,224	128,046	68,610	58,979	87,074	63,471	66,631	48,28
Dutch West Indies	474	300	103	363	442	1,436	1,985	3,367	8,552	4,534	1,403	757	1,298	2,96
Danish West Indies and Denmark	3,059	1,462	859	809	549	683	12,004	1,632	54	112	65	805	1,103	......
French West Indies	......	......	214	......	......	......	......	......	1,010	457	625	588	1,293	1,21
Puerto Rico	12,282	2,249	3,702	2,178	6,447	10,683	21,881	17,668	9,268	24,237	14,327	10,257	9,351	6,86
MEXICO	102,424	20,316	36,945	26,657	43,928	38,950	60,339	110,786	121,530	114,436	75,577	115,970	153,574	158,12
CENTRAL AMERICA	3,276	805	1,199	1,215	987	988	2,780	6,051	3,271	4,217	3,872	5,632	13,222	11,12
SOUTH AMERICA:														
British Guiana	......	140	65	......	......	......	......	58	504	......	610	1,049	136	2
French Guiana	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Dutch Guiana	......	......	76	......	......	......	......	......	......	......	......	......	......	16
Colombia	54,037	91,548	22,959	20,180	16,567	55,623	137,135	209,201	174,289	115,734	90,227	80,734	93,800	103,87
Bolivia	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Ecuador	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Brazil	74,550	102,785	125,149	123,284	152,841	159,534	272,513	61,958	72,071	72,446	29,483	21,158	21,814	39,99
Argentina	59,539	64,142	46,439	66,037	59,496	37,530	28,718	66,486	33,244	11,937	14,771	10,081	18,341	28,70
Uruguay	46,336	19,041	26,615	17,093	16,521	4,775	34,659	6,752	705	3,444	469	60	517	1,88
Venezuela	10,442	3,297	6,669	4,086	5,993	7,194	11,820	22,528	29,614	30,958	58,208	38,668	30,174	21,49
Peru	10,449	3,985	4,348	11,063	18,942	37,393	45,967	17,685	15,641	19,466	5,210	8,803	15,356	15,81
Chile	12,359	10,993	22,099	28,842	38,392	46,924	39,072	43,321	35,522	7,694	17,444	36,112	1,159	2,35
AFRICA	2,851	2,020	3,514	2,042	4,136	5,344	2,161	1,398	7,713	11,638	3,005	1,143	552	5,34
CHINA	70	246	1,858	617	4,004	849	10,673	9,654	1,654	296	1,144	1,353	1,066	1,30
JAPAN	......	360	716	867	774	1,669	22,644	19,524	9,195	1,272	1,244	921	2,786	87
HAWAII	1,205	......	......	2,649	1,674	1,950	1,660	1,976	2,536	3,138	3,425	5,609	8,681	20,96
EAST INDIES	6,418	1,591	841	940	......	......	......	......	......	195	......	40	......	58
ALL OTHER	17,070	4,279	33,431	4,259	13,613	8,118	4,108	1,893	2,325	3,187	9,667	1,922	3,661	9,08
Totals by years	1,999,274	1,650,340	1,657,942	2,051,581	2,233,326	1,898,864	2,436,085	2,150,720	1,594,296	1,797,929	1,742,764	1,743,293	1,661,715	1,648,91

VALUE OF AMERICAN SEWING-MACHINES EXPORTED.—*Continued.*

COMPILED FROM STATISTICS OF THE UNITED STATES TREASURY.

NO DATA FOR THE YEAR 1866.

380.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894	1895.	TOTALS BY COUNTRIES FOR 30 YEARS.
$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
....	....	....	....	16,381	5,565	1,945	1,889	2,736	1,111	1,417	14,492	3,850	2,920	5,413	12,160	81,709
4,135	16,683	23,630	31,411	56,956	63,944	56,671	55,862	41,515	40,337	34,022	50,626	43,302	53,938	48,363	36,200	780,846
0,269	41,160	59,921	72,074	49,059	67,027	99,461	102,026	72,457	92,885	115,978	116,046	269,387	52,757	91,246	98,566	2,645,045
2,407	522,564	708,950	814,176	1,136,037	814,114	680,604	384,610	398,114	213,904	456,884	609,750	616,936	563,401	255,407	472,203	15,417,683
2,204	5,656	6,178	31,574	41,437	40,533	53,377	41,152	5,829	...	12,471	34,417	32,869	47,365	4,673	22,613	403,800
0,449	3,628	5,120	12,054	9,866	10,093	13,443	21,527	38,350	3,956	4,059	10,832	15,820	12,307	8,696	8,756	204,821
35	511	993	......	....	2,044	1,763	1,069	20	1,63[illegible]	370	1,666	950	....	741	77	15,039
49	94	50	265	31,696	6,910	682	....	....	....	3,956	....	....	7,223	3,270	....	130,580
667	131	863	3,028	5,525	6,953	3,945	5,950	2,309	247	8,578	3,122	166	437	1,340	1,314	78,977
....	....	....	169	215	11,379	7,830	16,573	....	....	2,512	13,240	21,558	17,981	1,097	8,919	101,658
....	....	....	....	411	....	736	3,546	1,154	2,430	....	352	....	....	....	100	8,729
....	....	115	....	....	210	746	18,822	1,607	337	262	359	....	....	835	137	25,685
7,668	559,177	820,813	1,043,711	1,280,135	1,040,235	994,052	813,225	847,211	822,730	1,028,442	848,493	809,391	848,540	712,411	645,847	22,952,623
2,007	57,340	117,583	158,542	138,025	133,321	109,415	87,790	102,891	71,434	63,370	64,059	60,108	90,320	114,299	111,388	2,123,023
5,957	169,472	191,179	152,212	125,375	129,524	117,255	124,626	103,162	243,787	217,555	268,578	366,058	73,174	310,948	224,875	4,425,056
6,688	9,064	6,922	8,301	9,126	7,366	7,575	7,375	13,929	12,105	12,940	15,101	16,983	10,249	13,853	13,628	241,436
2,913	2,729	2,264	2,778	4,889	3,013	2,164	2,242	8,282	3,392	14,381	7,314	6,619	9,217	11,967	4,906	123,428
3,894	3,000	2,084	4,282	3,312	1,501	2,095	1,313	1,020	3,227	4,406	2,921	1,377	3,723	1,962	1,817	70,908
0,434	73,257	72,014	55,216	60,443	29,275	68,261	53,965	29,222	42,571	60,741	112,319	246,218	95,630	212,696	16,114	2,241,264
4,292	4,476	3,737	2,025	2,810	3,422	784	1,150	2,341	2,220	1,903	3,961	2,574	2,910	1,191	1,069	68,841
782	318	162	170	2,669	1,337	43	100	10	66	1,166	128	876	776	404	1,958	34,161
2,117	1,130	992	1,514	2,841	1,032	1,687	997	1,029	2,208	2,495	2,728	2,533	750	932	1,849	32,239
8,701	3,014	2,965	11,848	2,753	1,219	1,485	1,246	1,647	4,227	3,913	2,760	5,215	4,618	3,534	2,230	212,768
5,823	179,555	305,595	312,854	207,018	198,634	68,570	125,699	146,398	160,723	231,245	174,546	165,122	142,764	151,239	132,841	4,018,182
3,971	21,922	21,199	15,040	57,022	44,292	47,704	49,445	71,319	73,393	92,468	104,492	76,841	59,177	32,066	64,976	903,967
1,107	395	193	1,648	980	35	405	225	1,112	509	850	1,093	1,116	1,965	2,862	3,189	21,182
170	492	256	220	103	97	168	241	222	424	509	234	473	361	627	1,314	5,911
....	150	....	....	....	....	....	103	70	190	150	....	230	25	165	324	1,644
5,152	158,105	128,415	130,857	83,841	41,453	55,619	41,503	47,101	82,598	95,136	120,248	99,790	65,204	49,674	39,924	2,620,533
....	....	....	....	....	....	....	....	253	280	178	....	1,294	199	295	830	3,329
....	....	....	....	....	....	....	19,018	29,522	19,168	12,009	16,171	9,015	16,738	14,116	11,492	147,249
0,645	39,100	35,662	46,363	55,555	24,396	28,232	41,831	46,599	78,751	60,558	78,393	72,976	89,832	101,719	140,054	2,310,249
3,611	29,216	42,654	50,921	43,081	73,763	63,276	83,832	109,625	109,862	66,243	24,420	22,892	67,886	71,513	53,504	1,481,760
7,804	6,721	3,742	7,025	6,520	15,802	7,298	13,029	10,454	16,199	25,358	5,685	2,035	2,569	7,256	13,317	329,784
6,928	27,330	25,185	37,533	30,014	36,786	23,814	26,821	49,681	59,949	62,828	76,631	70,744	52,673	45,306	46,248	979,615
2,411	....	33	1,019	15,995	15,774	19,865	25,238	17,077	22,551	33,907	36,105	31,763	19,503	13,743	8,609	493,712
1,507	4,291	16,473	8,712	20,135	21,770	8,189	9,980	9,228	18,654	13,288	17,079	22,665	19,842	18,126	21,894	569,122
11,141	6,762	8,977	1,950	3,468	1,550	2,739	2,230	8,130	13,069	13,764	10,623	6,262	6,428	4,958	7,823	162,681
2,042	2,011	2,038	332	1,018	3,292	1,688	3,790	1,992	4,042	3,020	6,021	6,956	8,933	5,352	3,001	90,317
1,015	1,730	203	5,042	2,221	707	1,487	736	2,362	2,030	1,522	1,453	1,052	2,4[illegible]	1,265	3,465	91,632
14,075	17,274	23,894	23,145	16,804	8,847	9,240	13,634	10,606	10,367	16,876	16,289	7,026	7,318	8,818	9,968	269,649
....	....	....	645	510	2,029	831	1,386	2,162	3,483	4,685	3,942	4,573	6,815	3,993	1,363	48,028
6,297	13,866	6,461	8,751	24,336	16,222	15,352	7,057	6,352	6,289	7,365	6,888	8,387	7,479	8,983	9,277	276,378
9,367	1,982,324	2,647,515	3,061,639	3,552,814	2,808,698	2,584,717	2,212,853	2,245,110	2,247,875	2,793,780	2,883,577	3,133,992	2,476,446	2,347,354	2,260,139	$67,245,243

increase the quantity, quality, and value of their product, and to cheapen its cost to the consumer.

In the census reports relating to the principal manufacturing industries that use the sewing-machine largely, the figures show that the total value of their products in 1890 had increased about seventy-five per cent. from 1880. These census figures are given in a tabular statement which is appended, and which contains comparative data for seventeen classes of industry in the operation of which the sewing-machine is an important factor. These industries employed 661,000 hands in 1890; they had about $437,000,000 invested in machinery, tools, and implements of all kinds, and the value of their product approximated one thousand million dollars ($1,161,196,659).

introduced, and demonstrated that neater and more uniform work could be done on the machine. The result was the concentration of the scattered home industry into convenient factories, and the use of steam-power for driving the machines. The use of machines for stitching the uppers suggested the need of machines for sewing on the soles, and in 1861 the machine known as the McKay, under patents to L. R. Blake and others, was first put into successful operation. The time and money put into experiments on this machine, and the large amount of work which it performed, caused the owners of the patents to place a royalty on each pair of shoes sewed on it, as the only way to obtain a fair remuneration for their invention. The value of the invention to its owners may be estimated when it is stated

CENSUS STATISTICS FOR 1880 AND 1890 RELATING TO MANUFACTURES IN WHICH THE SEWING-MACHINE IS USED EXTENSIVELY.

Name.	Year.	Number of Establishments.	Capital.	Number of Hands Employed.	Value of Product.
Awnings, tents, and sails	1880	151	$522,700	1,268	$1,968,942
	1890	581	3,063,009	3,872	7,829,003
Bags, other than paper	1880	37	2,425,900	2,242	9,726,600
	1890	64	6,015,685	3,769	16,355,365
Bookbinding	1880	588	5,798,671	10,612	11,976,764
	1890	805	10,062,034	13,815	17,067,780
Boots and shoes (factory product)	1880	1,959	42,994,028	111,052	166,050,354
	1890	2,082	95,282,311	139,333	220,649,358
Clothing (men's)	1880	6,166	79,861,696	160,813	209,548,400
	1890	18,658	182,552,938	243,857	378,022,815
Clothing (women's)[1]	1880	562	8,207,273	25,192	32,004,794
	1890	20,811	34,142,607	109,606	125,235,751
Corsets	1880	113	1,611,695	8,802	6,494,705
	1890	205	6,640,056	11,370	12,401,575
Flags and banners	1880	11	54,300	68	119,600
	1890	29	376,130	364	455,849
Furnishing goods (men's)	1880	161	3,724,664	11,174	11,506,857
	1890	586	12,299,011	22,211	29,870,946
Gloves and mittens	1880	300	3,379,648	7,697	7,379,605
	1890	324	5,977,820	8,669	10,103,821
Hats and caps, not including wool hats	1880	489	5,455,468	17,240	21,303,107
	1890	705	13,724,002	27,193	37,311,599
Hat and cap materials	1880	64	746,828	1,159	2,217,250
	1890	73	1,709,650	1,705	3,465,524
Pocketbooks	1880	53	598,350	1,413	1,769,036
	1890	62	1,121,834	1,348	2,165,462
Rubber and elastic goods	1880	90	6,057,987	6,268	13,751,724
	1890	139	13,703,787	9,802	18,708,917
Saddlery and harness	1880	7,999	16,508,019	21,446	38,081,643
	1890	7,931	35,346,620	30,326	52,970,801
Shirts	1880	549	6,841,778	25,687	20,130,031
	1890	809	14,273,611	32,750	33,638,593
Horse clothing	1880	3	410,000	565	695,000
	1890	31	1,028,523	952	1,572,265

[1] The figures for 1880 relating to the manufacture of women's clothing do not include custom dressmaking establishments. In the figures for 1890 all such establishments are included that had a product exceeding $500 in value.

In no branch of manufacture has a greater revolution occurred than in boots and shoes. The fitting of the uppers was formerly accomplished by sending them out in small quantities to be sewed and stitched by hand in the homes of the operators. The hand-workers bought sewing-machines when they were that as many as 900 pairs of shoes have been sewed on one machine in one day of ten hours; that the average license was at the rate of two cents per pair; and that over 350,000,000 pairs of shoes had been made on it up to the year 1877 in the United States, and probably an equal or greater number in Europe.

The McKay machine made the chain-stitch with a waxed thread. The outer sole was stitched to the inner sole by removing the last and placing the shoe on an arm similar in its general appearance to the human arm, with elbow bent to hold up the hand and swing around on the shoulder-joint, so as to bring the needle and awl in the overhanging arm into position above the shoe, to take up the thread from a very ingeniously worked underneedle in the arm inside of the shoe. The awl also had a lateral movement, and acted as a feed to move the shoe forward as each stitch was taken. This very useful and meritorious machine has been superseded to some extent by the Goodyear machine, which makes the lock-stitch with waxed threads and sews on the sole in the same manner that it is done by hand. In the Goodyear process the last is left in the shoe, and the welt is sewed to the inner sole and upper by a machine making the chain-stitch, that not only does the sewing, but also draws the upper tight on the last and greatly assists in "lasting" and giving proper shape to the shoe. The outer sole is then sewed to the welt in a manner that successfully imitates the very best of hand-work. The Goodyear machines are sold on a royalty plan based on their production.

The next sewing-machine of great importance was for working buttonholes, and was made under patents to Vogel, Humphrey, and others. After years of experimenting the Union Buttonhole Machine Company produced a machine that was a marvel in its line. It worked buttonholes that had the peculiar "purl" of the best hand-made buttonholes, to which they were superior in strength and finish. The manufacture and sale of this machine was not profitable to the Union Buttonhole Machine Company, and in 1867 it passed to the Singer Company, and by that company was still further improved and became a great success, having a large sale in the United States and Europe.

The Reece buttonhole machine was brought out in 1880; it is a wonderful organization of machinery, and has had a large sale on the royalty plan, making it very remunerative to the owners of the patents.

During the early years of the sewing-machine, its use by clothing manufacturers was confined to the production of the medium grades, the custom tailors showing a great prejudice against machine sewing.

This prejudice gradually disappeared as it became apparent that seams made on the machine were equal to the best handwork, and the sewing-machine is now in general use for making the finest garments.

The enormous increase during ten years in the factory production of clothing is remarkable, and it may fairly be claimed that the development of this industry has been coincident with the invention of special appliances and attachments adapting the sewing-machine for factory operation in the performance of all stitching processes, including buttonhole and eyelet making, attaching buttons, staying seams, etc.

The concentration of clothing manufacture into factory operation has effected greater economy in the marketing of the cloth, especially the cheaper fabrics, such as jeans, shirtings, denims, etc. These are now sent from the mills where they are woven directly to the manufacturers of clothing, shirts, overalls, etc., thus saving the cost of commissions and handling, formerly incurred through the wholesaler, the jobber, and the retailer to the local tailor or housewife. Several hundred sewing-machines are sometimes operated in a single power plant for the manufacture of clothing.

By the use of improved methods for cutting to standard sizes in great variety, well-fitting garments are now as easily obtained in "ready-made" as in "custom" clothing. By the use of the sewing-machine they are as well made, and are furnished to the wearer for what the material formerly cost him.

Economies of equal importance have been effected in many other industries in which the sewing-machine is the principal element of productive force.

While these industries have thus been enabled to more than double their output during the last decade, the population of the country has only increased about one quarter. It is evident, therefore, that the quantity of sewing done in the home has been greatly reduced, and that domestic burdens have been correspondingly lessened; also that the cost to the consumer of the products of the sewing-machine has been reduced, all of which may fairly be claimed as the results of inventive genius and executive ability in the field of sewing-machine manufacture, its development and improvement.

In the preparation of this article the writer has received invaluable information and assistance from Mr. John F. Elliott, who has been intimately connected with the sewing-machine industry in many capacities for nearly forty years; and much credit must be awarded him for the research and investigation which have given this brief history whatever of value it may possess.

F. G. Bourne

CHAPTER LXXXII

AMERICAN WATCHES AND CLOCKS

CLOCKS were among the first articles of a complicated construction which were made in America. In 1765 there was in Grafton, Mass., a remarkable family named Willard, all of whom were clock-makers. There were three brothers, named Benjamin, Simon, and Aaron. The two former removed to Roxbury, Mass., in 1771, and established themselves there as clock-makers, on Roxbury Street, at the "Sign of the Clock," where Simon remained over seventy years, dying at the age of ninety-six. He was the best workman and the most ingenious of all the Willards, as he not only made several kinds of clocks, but invented a number of machines for various other purposes. He was only thirteen when he made his first clock, all the work being executed by him, thus showing the character of the boy. There was no machinery in those days by which labor could be saved, and everything was filed out from the rough. Somewhere in the latter part of the last century or the early part of the present, he invented and patented the "timepiece," so called, which very soon superseded the tall eight-day clock, which before was the only method of recording time. He was also the inventor of perambulators for accurately measuring distances, cook-jacks, alarums, chimes, etc. He made many turret clocks for public use in Boston, New York, and Philadelphia, as well as one for the University of Virginia. In Virginia he became intimately acquainted with Thomas Jefferson, our third president, and James Madison, our fourth president, corresponding with them for years. Jefferson had a strong mechanical turn of mind, and liked to divert himself with curious problems. Willard made and set up the clocks in the United States Senate Chamber and in the House of Representatives, performing the latter labor after he was seventy-five years of age. He never considered profit, the quality of work being everything. His clocks, great and small, are just as good, after the lapse of a century, as when they left his hands.

Aaron, a younger brother of this family, settled in Boston, Mass., building what, for the times, was a large establishment, on Washington Street, Boston Neck, near the Roxbury line. His particular branch of business was the tall striking clocks for halls. These he manufactured almost exclusively; they were of excellent workmanship, and stood every test. His clocks were largely sold in Virginia in exchange for Haxall flour, a trade which proved very advantageous to him. He died at about the age of eighty-five. The fourth Willard, Aaron, Jr., was also a clock-maker, being the son of the one just mentioned. He was born in Boston, Mass., and was taught clock-making by his father, afterward setting up in business not far from where his father was located, and there making various forms of clocks for common and extra use. His business was not large, no more than four or five workmen being employed, the most of whom were apprentices. The shop he occupied was thirty by fifty feet, and one story high.

My connection with clock-making commenced at the age of sixteen, in 1829, under the instruction of Aaron Willard, Jr., with whom I served an apprenticeship of five years. The aggregate production of Mr. Willard in money value would not exceed $8000 per annum. During my five years of apprenticeship not a single tower or hall striking clock was made by us, although now there are hundreds, if not thousands, of these kinds of clocks made every year. In 1875 there was only a small amount of such work done, as compared with what has been accomplished during the last twenty years. Then there were only a few clock-makers scattered throughout New England,—mostly in Connecticut,—whose united production only amounted to a few thousands of clocks yearly, while

Edward Howard.

now there are numerous clock factories of immense size, filled with the most ingenious labor-saving machinery. The demand then was limited to the United States alone; now we have the whole world for a market, and the demand and supply run into millions every year. Then the forms, styles, and finish were few; now they are almost innumerable, it seeming impossible to conceive of anything novel. Clocks were then often set by the noon sun-dial, but now we make them to run so close to true time that we sometimes think the sun has gone wrong. The tower-clock business has had a wonderful growth in the past thirty years, and more have been made and put up in that time than during all the preceding period from the time of the landing of the Pilgrims at Plymouth. Some that I made fifty years ago are now running, being still in good working order.

I went in business for myself, as a clock-maker, in 1840, continuing up to 1882, when I retired from active industry. During that time I manufactured various kinds of clocks, many being specially designed for halls, churches, offices; also electric watch clocks, tower clocks, etc. I began in a shop not over thirty feet square, and ended with a number of buildings, one of which was one hundred and fifty feet long, seventy feet wide, and seven stories high. The clock-manufacturing companies are not very numerous in the United States, not exceeding twenty-five in all; but their size and facilities are so great that it does not take long to flood the market when they are all in operation. I commenced the clock business single-handed, but later employed from 100 to 200 hands. The amount of capital invested in clock-making in 1795 is very much a matter of conjecture, as well as the amount of yearly production at that time, but it is probable the former did not exceed $100,000, and the latter could not have been over $250,000.

The most extensive clock factories at the present time are located as follows: New Haven Clock Company, New Haven, Conn.; Waterbury Clock Company, Waterbury, Conn.; Seth Thomas Clock Company, Thomaston, Conn.; J. E. Ingraham Clock Company, Bristol, Conn.; Gilbert Clock Company, Winsted, Conn.; Phelps & Bartholomew Clock Company, Ansonia, Conn.; E. M. Welch Clock Company, Forestville, Conn.; E. Howard Clock Company, Boston, Mass.; F. Knoeber Clock Company, New York City; Ansonia Clock Company, Brooklyn, N. Y. Their combined capital in 1860 was about $885,000, and production about $2,300,000. The combined capital in 1892 was $5,550,000, and the production in that year, $10,475,000. No sufficient data exist before 1860 to make any satisfactory estimate of the capital invested or the amount of yearly production; but it can be seen that for the last thirty years there has been a large and continued increase of capital and production, and it is fair to believe that it will continue to grow.

Watchmaking did not exist in the United States as an industry in 1795. There were watchmakers, so-called, at that time, and there are great numbers of the same kind now, but they never made a watch; their business being only to clean and repair. Watchmaking, as a business, was not started in the United States until 1850. Its commencement on a comprehensive and systematic method was the result of many deliberations during the years 1848 and 1849, between Mr. Aaron L. Dennison and myself. Mr. Dennison was a first-class watch repairer, none being better, and he knew from experience that there was no proper system employed in the manufacture of watches. In watches purporting to be of the same size, of the same makers, there were no two alike, and there was no interchangeability of parts. Consequently it was "cut and try," by which a great deal of time was wasted, and many imperfections resulted. Mr. Dennison being a watch repairer, and myself a clock-maker, we made a good combination to systematize watchmaking, and to invent labor-saving machinery for producing perfect and interchangeable parts. With such views and intentions, we began the watch business in the spring of 1850, building a factory in Roxbury, Mass.

It is almost needless to say that we met with many obstacles. We were told by importers and dealers in watches that we would never be able to carry out our plans, and that our project would be an utter failure. Some of our friends even told us we were crazy to attempt such an undertaking, but we were Yankees, both of us, and had a sufficient quantity of the proverbial "grit," and at least believed in ourselves, even if others did not have so much faith. We could not import and use foreign help, unacquainted with our methods or tools, so we had to instruct our men from the beginning. There were many times when we felt that the predictions of the importers would prove true, but perseverance, money, and brains conquered. The financial problem was a hard matter to solve, as the unbelief in our success was universal. Frequently it was difficult to raise the necessary funds to carry on the work. This struggle was continued for six years before the tide turned. The company's best friends during that time were Samuel Curtis and

Charles Rice, both of Boston. Without the financial assistance of these gentlemen, watchmaking would probably not have existed at the present time as an organized industry in the United States. This may seem to be a sweeping statement, but no one can conceive the trials and tribulations that Mr. Dennison and myself endured. We hear and read about going through purgatory, but that must be a species of pleasure compared with what we experienced at that time.

We were trying to establish under one roof an industry embracing at least a dozen distinct trades. Such a thing had never been done before, and we were still further handicapped in our undertaking by having only inexperienced assistants. We had to teach ourselves first, and then teach others, making our progress slow and expensive; and there was much bad work that we were obliged to throw away. We did not know how to make a jewel, or a dial, or a tempered hair-spring, or to do proper watch-gilding or to produce a mirror polish on steel. Each one of these operations was a feat of which the ways and means had to be studied out and worked over until, after many attempts, one at last would be successful.

All the tools to make the different parts, after being designed or invented, had to be made in the factory by the machinists then employed, under our own supervision, in order to have them perfect and durable. Attempts were made to have them executed outside, but it was impossible to get them constructed carefully. When it is understood that if many of the parts of a watch are one five thousandth of an inch thicker or thinner, longer or shorter, larger or smaller, than the proper sizes, the watch will not run well, it will be seen at once that the tools must be as near perfection as possible, to produce the exact and uniform sizes needed. It was more than three years before the establishment had fairly and fully started in the business of making watches, and then it was found that it would require ten times as much room as had been provided, and we set about building a very much larger factory at Waltham, Mass., where the American Waltham Watch Company's works now stand. We removed there in 1854. The company remained at Waltham, making watches, until 1857, when it met with financial reverses, and the property was sold to Royal E. Robbins in settlement of its affairs. Up to that time the watch factory had been under the name and style of the Boston Watch Company. I then returned to the first factory at Roxbury, when a new company was formed as successor to the Boston Watch Company. It was entitled the Howard Watch and Clock Company, and had a nominal capital of $150,000. It was necessary to begin at the bottom and make all tools anew. Mr. Dennison left me in the early part of 1857, but after Mr. Robbins bought the factory at Waltham, Mr. Dennison was employed by the new company for two or three years.

During the War of the Rebellion the Waltham Watch Company became a great financial success as well as a mechanical one. At that time the premium on gold increased the price of watches so much that very large dividends were paid, which occasioned the establishment of several new watch factories in different parts of the country. Nearly all the companies were obliged to increase their capital from two to four times the amount originally believed to be necessary before they were successful, while several never did succeed.

Previous to 1853, many thousands of English and Swiss watches were imported into the United States yearly. At that time the American manufacturers had begun to control the market, and in a few years more the importation of English watches had generally declined. At present this trade is of little or no account. The importation of Swiss watches was also very much reduced at the same time, but the Swiss have in the last five years regained a part of their trade by adopting American methods and machinery.

In 1866 the American market was not only mostly supplied with American watches, but extensive offices were also opened by the American Waltham Watch Company in London, where their watches met with ready and extensive sales, the business continuing to this day. An attempt was made several years ago to introduce the American plan of watchmaking into England, a set of American machinery being set up there, but it did not prove a success. There was also a plant started in Switzerland by two Americans about the year 1869, to be carried on in the American manner. The machinery was all made here and sent over. A plant was started in the West a few years since, which had a lingering life, after a while being moved to San Francisco. It did not succeed there, so it continued its journey to Japan, where it is a fixed institution, and soon will be in competition with Americans in their home market. This will be hard to meet, as a workman can live there on four cents a day and get rich on eight cents a day. It would sometimes seem that Americans are altogether too good and accommodating, desiring to let the whole world know what they can

do, and just how they do it. On the other hand, I do not believe they care to learn of the Japanese how to live on four cents a day.

A well and properly made watch has wonderful qualities as a machine, considering the labor it has to perform and the length of time, if treated with a very little care, it will continue to do its work. It is conceded that every person in the world has a distinct individuality, and it is just so with every watch that is made. Some of the parts are so minute that, although you suppose you have them all alike, the fact is that no two have been made without some little variation, having an appreciable effect on its action as a timekeeper. That is where the individuality comes in. The lowest or medium, grade watch may be found, occasionally, to be keeping better time than some of those which have had a great deal of time spent on them to make them as nearly perfect as possible, yet if you take the latter in pieces, and thoroughly examine them in all the parts, you cannot find any cause for the defect. Therefore I say that each watch has an individuality of its own, as all human beings have, and we must make the best of such a condition. Does any one ever consider the amount of labor that is performed by a watch during its lifetime, which is fifty years at least? In its daily duties the balance vibrates 18,000 times each and every hour, 432,000 times a day, or 157,680,000 times a year. The hairspring makes the same number of vibrations and an equal number of ticks from the escapement. The first thought would be that the machine would be worn out in a year, but this does not prove true. If it is a good watch you can multiply 157,680,000 by 50, which would give 7,884,000,000 pulsations, and yet the watch will still be in good condition. This is a wonderful record, considering the small amount of food that has been consumed by its constant action. I say food, for whatever labors must be fed, and the watch lives on about sixteen inches of mainspring every twenty-four hours. It is cheap feeding, however, as the spring is not digested, but only the power which is stored in it, which costs nothing to renew daily. Thus it goes on, with very little care, year after year, having no palsied hands, no wrinkled or care-worn face, no failing heart-beats, but with the same vitality as ever.

The people of the United States are to be congratulated on the successful establishment of such an important industry as watchmaking within their borders, on such a magnificent scale as at present, and with so great a future before it. There have been wonderful strides in the last twenty years in the quantity and quality of the movements. There has been so much improved automatic machinery that the cost of production has been greatly reduced, at the same time that the quality has been improved. At the present time there are no key-winders made, but all are stem-winders and stem-setters. They are also nearly all made so that if the mainspring should break, while wound up, no damage would happen to the train, which is an advantage over all others.

The principal watch-manufacturing companies doing business on an extensive scale, at the present time, are located as follows:

Name.	Place.	Organized.
The E. Howard Watch Company	Boston, Mass.	1850
American Waltham Watch Company	Waltham, Mass.	1859
Elgin National Watch Company	Elgin, Ill.	1864
Illinois Watch Company	Springfield, Ill.	1870
Rockford Watch Company	Rockford, Ill.	1874
United States Watch Company	Waltham, Mass.	1883
Trenton Watch Company	Trenton, N. J.	1883
Hamilton Watch Company	Lancaster, Pa.	1892

The combined capital of the above at the commencement of the business, as nearly as can be ascertained, was $1,502,110. Five years later the yearly sales were $3,379,344. The capital in 1892 was $10,550,000, and sales in that year, $15,838,817.

E. Howard.

CHAPTER LXXXIII

AMERICAN TYPE-WRITERS

THOSE who tell in these pages the story of the progress of a century in the many lines of life's activities, record a history of achievement which, for growth in volume, in character, and in method, is marvelous and unequaled in the history of any other nation or of any other time. But all who write will concede that the American type-writer has been a factor in the growth and progress of other lines of commerce, and it must be admitted that had the American type-writer come into being in the early part of the century, instead of toward its close, a greater advancement would have been recorded in every particular line of industry, because of the assistance which the type-writer would have rendered.

The type-writer, world-wide in its use, is essentially and almost entirely American. True, the idea of reducing the manual labor of writing, so far as the records show, first occurred to an Englishman. The earliest patent on mechanical writing was granted to an Englishman nearly two hundred years ago. He thought that there might be an easier method of writing than that practised by his forefathers; but the machine which he devised did not prove to be practicable. One hundred and fifty years elapsed between the first and the second English patents on writing-machines. The Englishmen are slowly awakening, for there have been issued up to the present time 375 English patents for improvements in type-writing machines. Many of these have, of course, been granted to American inventors, and those which have been granted to Englishmen have made no mark in writing-machine history; for no machine has yet been made in England, nor, for that matter, anywhere outside of the United States, which has found any extensive sale, or which has equaled, in any way, any one of the leading American type-writers.

While our English cousins slept, and while they have been rubbing their eyes and partially awakening, American genius and ingenuity have been at work. Beginning in 1836, when the first American patent on a type-writer was granted, patents were taken out at an average of about one a year for forty years. Our early American inventors were, however, not very successful in their attempts to produce a practical writing-machine. For thirty years nothing of especial value was evolved, or, if any practical machine was, during that period, invented and patented, the faith and the capital requisite for commercial success were not enlisted in its behalf. We can, therefore, not fairly date the beginning of the history of the type-writer as a factor in commercial life further back than the patent granted in 1868 to C. Latham Sholes (now deceased), who was then collector of the port of Milwaukee, and an editor, a scholar, and a man of genius. His inventions, patented in 1868 and later, formed the foundation of the first American type-writer, and covered a basic principle upon which all successful type-writers have since been made. Since the patent was issued to Mr. Sholes some 1200 American patents on type-writers have been issued, including, it would seem, every conceivable modification which can be made in such an instrument, and yet no one has devised any plan of constructing a machine on a better principle than that invented by Mr. Sholes.

In discussing the American type-writer and the type-writer business, therefore, we may be said to be considering the whole field of the type-writer industry, for our American type-writer manufacturers have no competition from abroad, either in home or in foreign markets. We are discussing, too, a business which has grown from nothing in twenty years. The first type-writer was offered for sale in 1875; but so few were made and put in use in that year that it may properly be said that the beginning of the business dates from the introduction of the machines at our Centennial Exhibition held in Phil-

Clarence W. Seamans

adelphia in 1876. Shall we be able to show that within twenty years the type-writer has won its way into usefulness and popularity to an extent such as justifies the assignment to it of a place in these pages among the first one hundred American industries? Let us see.

When the type-writer made its bow and offered itself as a candidate for public favor, it was looked upon as a plaything rather than as an instrument of genuine utility, as a toy rather than as a practical labor-saving implement. It wrote in those days with capital letters only, and though the work which it produced was a great improvement over the illegible chirography of many lawyers and business men, objection was nevertheless raised to it on account of its monotonous appearance. Notwithstanding these objections, the early machine, cumbersome and unsatisfactory as it was, was accepted as a helper by men whose business required an amount of writing which was irksome; and 3000 or 4000 of them, writing capitals only, were made and sold within three years from the first introduction of the machine, and before the makers had worked out a plan for constructing a machine which should write with both capital and small letters. The sale of 3000 or 4000 machines by no means established the business upon a firm basis, nor did it even result in a general acceptance of the machine itself as a useful article. While a few men here and there used the type-writer with acknowledged advantage in their work, just as a few of the older boys of that time used and appreciated the bicycle (velocipede) of a quarter of a century ago, the great majority of business and professional men failed to see any real merit or advantage in it. Even after the machine writing both capital and small letters was, in 1878, presented to the public, the type-writer salesman was generally looked upon as offering an article of no real merit; and the men who have been from fifteen to twenty years in the business well remember the discouragements and rebuffs which they met in their endeavor to show business men that a writing-machine was a useful adjunct to a business office. Even the judges of some of our courts refused to accept type-written documents, strange as such a thing may seem in these days, when it is a rare exception to find any legal document not written with a type-writer.

But this condition of public sentiment could not, and did not, long prevail. The type-writer had merits which could not be permanently ignored. From its inception there were a few men connected with it who knew its usefulness and realized its possibilities, and they pinned their faith and their future to it, and never wavered nor lost faith in it during the half-dozen years of its early history, when the skepticism and the opposition of the people who might have used it with profit made the cost of selling the machines much greater than the profit realized upon them. So much was this the case that, when the first 10,000 machines had been sold, not only had no money been made in their manufacture and sale, but the business had been conducted at an actual loss of something like $250,000. It will, perhaps, serve no useful purpose to narrate in detail the history of the struggles of the invention during the first half-dozen years after its introduction upon the market, and the names of the men who, during that period, labored to make it a success. Some of them were men of marked ability who had achieved success in other lines of trade.

Men of equal faith and energy, with steadfastness of purpose and the benefit of the experience of those who had preceded them, came later, and to these new men fell the control of the sale of the machines. New plans for the education of the public were adopted. Advertising was done in a more systematic and a more extensive manner. The public was given to understand in an emphatic way that the day of doubt was passed, and that the type-writer was a mechanical and a commercial success. The wheels began to revolve more rapidly. The growth of the business became more marked. Americans believe in success. We like to buy of successful houses. Convince us that an article is useful and that it has passed the experimental stage, and we adopt it. The latest ideas, the most improved methods and machinery, are none too good for us. We revere the memory of our fathers, but we are willing to use better tools than they had, and not, like some of our foreign cousins, adhere to the calamus, the stylus, or the quill, because they were used by their ancestors; and so when the writers in business and in the professions once realized that the type-writer would lighten their labors, the machine found ready sale.

Then began the competition; for as soon as success attends the manufacture or sale of any article in this country, just so soon does some enterprising American devise a modification or a substitute for the original article, and he launches it upon the market in the hope of getting a share at least of the profits of the business. At first, competition came slowly. When the first machine, the Remington, had been on the market ten years, two competitors were in the field. Since that time several new

machines have been launched each year, until now they aggregate, taking them all, about 100. Perhaps this statement ought to be modified. About 100 have been at one time or another on the market during the past ten years; but the law of the survival of the fittest has been in operation, and the manufacture of eighty or more of them has been discontinued. The mention of the names of the machines which have thus come and gone can hardly prove of interest. They have had their day. We shall see them no more. Let them rest in peace. Neither is it the purpose of this article to particularize the machines which have survived. Is it not better to group them together and to treat them as a whole, showing what they have unitedly accomplished in the two decades since the leader made its appearance upon the market?

Gradually, the usefulness of the type-writer began to be appreciated. First the professional stenographers—court reporters—took it up. Then the lawyers saw that the reports furnished them by the court reporters were more legible when written with the type-writer than with the pen, and they became purchasers. Commercial men still held aloof. They thought it might be all very well for legal documents, but not for business correspondence. The mercantile agencies realized the great usefulness of the machine, and they began to use it in their offices, scattered over the world. Presently the machine was found in the counting-room of the leading dry-goods house in America, and other houses in the same line of trade followed the example. One after another the principal houses in each branch of manufacture and of trade realized that a type-writer could be made useful, and adopted it. A list of the early users of the type-writer would show that those who were the first to appreciate its advantages were then, and are still, the leaders in the professions and in commerce. When once the leaders had committed themselves to it, the smaller concerns followed in that, as they usually follow in other things.

Until 1880 the sale of the machine suffered for lack of skilful operatives. Business colleges, schools of commerce, and similar institutions were then prevailed upon to engage in the work of qualifying young men and young women for employment in the use of the type-writer. The schools helped greatly the type-writer business, and the type-writer people helped the schools. The increased advertising and soliciting of salesmen, as one machine after another made its appearance upon the market, brought the machine more prominently to the notice of business and professional men. Curiosity was awakened, then interest aroused; investigation followed, then purchase. By 1885 the permanence of the machine as an institution, and its prosperity as a commercial enterprise, were assured in America. From that date until the present the business has had a steady growth, uninterrupted in its yearly increase, except by the temporary set-back due to the commercial depression of 1893 and 1894, from which it is now rapidly recovering. Starting with 1000 in 1880, increasing to 5000 in 1885, the sales had reached the respectable figures of 60,000 per year in the early part of 1893, exclusive of the many thousands of low-priced machines which were annually sold, and which are not considered in this article except to give them credit for the work they do as educators, used, as most of them are, as toys, but serving a useful purpose by convincing thousands of people of the value of a better machine in the actual business of life.

As this article is not intended to be a detailed history of the type-writer as an invention and as a business, but rather to show its origin and what it has accomplished, few names are mentioned and few figures given. Commercially it occupies no mean position among our business enterprises. Beginning within a very few years, it has grown from nothing until it now occupies ten acres of factory-floor space, and furnishes employment in its manufacture and sale to 15,000 people; but those who derive their income and their livelihood directly from their connection with the manufacture and sale of the machine are few compared with those who are furnished employment through its use. Let us consider the changed conditions regarding its popularity. For years rejected and its usefulness denied, it has worked its way by its own merit into every professional office and every counting-room of prominence in the land. It is found in every State and national capitol, and even in the Vatican. It figures in every political movement, and the first step in any political campaign is the opening of a headquarters and the installation of a corps of type-writer operatives and machines. One of the first articles in furnishing a new office or in starting a new business is a type-writer. Even if there be no work for it to do, it is put in to give an appearance of business. Considered a few years ago as fit for only the most unimportant documents, it is now used for the most important work of the American and foreign governments. Nearly 2000 machines are used in the offices of the government departments at Washington, and it has been formally adopted for governmental use in England and her colonies, France,

Germany, Russia, and, indeed, in nearly every country on the globe. Many of our States have placed laws upon their statute-books legalizing its work. Judges who once objected to it now require that it be used in the production of all papers submitted to them. It is used for drawing deeds, for writing wills, for state and diplomatic correspondence. Even foreign noblemen and potentates have adopted it. The Queen of Madagascar has her type-writer; the khedive of Egypt has his. The czarina of Russia acts as secretary for her husband, the czar, and does her work on the type-writer. The little machine, once so unpopular, has invaded the realm of fashion. Our English cousins were more slow to admit the propriety of using the type-writer for personal correspondence, but merit and usefulness have won. Among the wedding gifts to Princess May of Teck was an American writing-machine. The acknowledgments of the wedding presents of another one of the royal family were written upon a type-writer, and the Prince of Wales himself has recently brought Marlborough House up to date by the introduction of an American writing-machine. A representative of one of the leading American manufacturers has been decorated by a foreign ruler with a distinguished order, in token of his appreciation of the ingenuity and value of the American writing-machine, which is used extensively by his Excellency's government, and even by his Excellency in person; and the leading firm of American manufacturers has received the appointment from her Majesty, and his Royal Highness the Prince of Wales, of contractors to her Majesty's government.

So much as to its present popularity at home and abroad. Now what has it accomplished? It has made itself a factor in the increase of business in all lines of trade. It has enabled a telegraph operator to supply at one writing every newspaper in New York with the news of the day. Its speed has resulted in an abbreviation of the original Morse system. By the use of the new code the capacity of a telegraph wire is doubled, resulting in great savings to the telegraph companies. It has shortened the number of hours during which a business man is confined to his correspondence, and has given him a greater portion of the day to devote to other things, to the advantage of his business. It has improved the correspondence itself, so that letters are more easily read and the contents more quickly grasped. The greater legibility of its work prevents many errors and consequent loss. The head of a Wall Street house, overloaded with a certain stock, and desiring to realize upon a little of it without affecting the value of the rest, sent a message to his broker on the floor of the Exchange: "Sell quietly 1000 shares." Illegible handwriting made the message read, "Sell *quickly* 1000 shares." The hasty sale demoralized the market, broke the price, and the house failed. Had the message been type-written the failure would not have occurred. It has increased the trade of those who have used it, and has driven the fogies out of business, or compelled them to adopt it. It has educated the public in spelling, in punctuation, in capitalization, and in paragraphing, to a great degree. Compare business letters of twenty years ago, all of them written by hand, with business letters of to-day, nine tenths of them written on a type-writer, and observe the improvement in these respects. It has lessened the laboring hours of thousands of men, giving them more time for recreation, and perhaps lengthening their lives. It has in a measure solved the problem of women's work. It has opened an avenue of genteel and profitable employment to an army of educated women.

To those who are permitted to look back over their connection with the business from its infancy, and recall the struggles and discouragements of the first few years, its present popularity is naturally a source of pride; but even more gratifying is the contemplation of the vast army of young people who, as the outcome of those struggles, have found congenial and profitable employment. To fully impress upon the reader what the type-writer has accomplished in this respect is no easy task. One writing-machine company, realizing the mutual advantage which would result, began in 1882 the work of finding employment for type-writer operatives. Employment bureaus were established in the principal cities of the country, and have been continued until now, at a cost of many thousands of dollars, serving without charge both employers and employees. If the young people—mostly women—who have found employment through the agency of this one house could march through one of our city streets, shoulder to shoulder, from curb to curb, it would require from daylight to dark for them to pass in review. Would the size of this army be more easily comprehended if the number is mentioned? Here, then, it is—70,000.

What, too, of the earnings of the legion of young people who, by means of the type-writer, not only support themselves, but in many instances contribute to the support of others? The entire amount paid as wages to operatives has been found to be

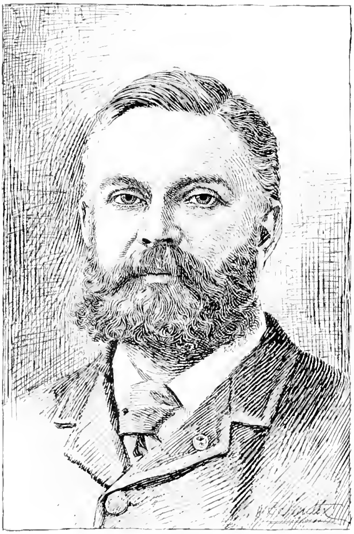
$150,000,000 yearly—a sum greater than the customs receipts of the United States; greater than the cost of maintaining the army and navy or the entire civil list of the government; a sum equal, in fact, to the entire cost of the public schools of the nation. This vast amount of money has been earned without corresponding loss of employment by any other class, and may certainly be said to have added an equal amount to the wealth of the nation.

Who deserves the greatest credit for these accomplishments? A measure of credit must be given to those who first conceived the idea of decreasing the labor and of increasing the speed and legibility of writing; but this credit must be divided among many persons. Credit is also due to the men of business acumen who, taking up the enterprise when the crust of opposition had been broken, used their ability, their money, and their energy in establishing the business firmly in public favor and confidence, and made it profitable. Space will not be taken to discuss those whose inventions have added to the value of writing-machines, but who were not pioneer inventors in the field; nor those who, having invested their money, devoted their time to getting a share of the profits of the business, after the leaders in its introduction had demonstrated that it was an enterprise which could probably be embarked in with profit.

Above all others, credit seems due to three men, all of whom have finished their work and entered into their reward: James Densmore, who, when the idea was unpopular, invested several thousands of dollars,—all that he had,—and who, when he had used all of his own means, had the faith and the courage to borrow from others many thousands more, all of which he spent in converting the public to his ideas; George W. N. Yost, Mr. Densmore's lifelong friend, who with no less faith worked with him from the beginning, and who possessed in a remarkable degree that enthusiasm and tenacity of purpose required to overcome public prejudice; and William O. Wyckoff, who believed in the machine from the time he saw the first crude model, and was among the very first to use and sell it, and who, with better business ability than either of the others, had not only the faith to invest his money in the enterprise at the dawn of its history, in spite of the protests and the ridicule of his friends, but had also that prescience which told him that sooner or later the whole civilized world would want typewriters. When the hour came it found him ready. Dropping all other tasks, he put into the work all that he had of means, of energy, and of enthusiasm, with results so magnificent as to command universal wonder and admiration.

To revolutionize commercial methods; to give employment even indirectly to hundreds of thousands of young people; to add annually to the nation's wealth hundreds of millions of dollars, are no mean accomplishments. These results have been attained through the instrumentality of the American type-writer.

Clarence W. Seamans



ALBERT A. POPE.

CHAPTER LXXXIV

THE BICYCLE INDUSTRY

THOUGH the idea of man-power locomotion is an old one, its practical development is a modern achievement. What appears to be a machine of the hobby-horse type is illustrated in a stained-glass window of the old English church at Stoke Pogis, whose graveyard is famous as the scene of Gray's "Elegy" and the final resting-place of the poet's remains. This window bears the date 1642, but as no records throw further light on the subject, it must be taken as an isolated point in the history of wheeling, or perhaps be considered merely the strange product of an artist's imagination.

Within the space allotted to this subject it would not be of advantage to describe, even in outline, the crude devices which appeared during the early experimental period; yet their number and variety are of interest as showing how persistent inventors were in their search for a vehicle with which the muscular force of the human body could be used to such advantage as to secure an easier and more rapid transit than was attainable on foot.

The first rudimentary bicycle of which we have a fairly satisfactory record was a machine used by Baron von Draise, of Mannheim-on-the-Rhine. It was of great service to him in the performance of his duties as Master of the Forests of the Grand Duke of Baden. From him it took the name "draisine," though the claim of priority in invention has been questioned, as a wheel of the same type—the célérifère—was exhibited in 1816, in the Garden of Tivoli, a favorite Parisian resort of the day. The construction of this machine was very simple, consisting of two wheels in line, connected by a perch on which the rider sat, and to the fore end of which the front-wheel fork, bearing a cross-bar for steering, was swiveled. The rider propelled this contrivance by quick thrusts of his feet upon the ground, but on down grades they were held up and the machine allowed to coast. Johnson's pedestrian curricle, brought out in England in 1818, was an improvement in detail over the draisine or célérifère, and at once came into favor under the names of "dandy-horse" and "hobby-horse." In 1819 machines of this kind were introduced into New York, where people took kindly to them, riding them on the Bowery, through the parks, and even speeding them on the decline to City Hall Park. It was during this year that W. K. Clarkson was granted a United States patent for an improvement in the velocipede. Little or no progress was made for a number of years after this, but a great problem was successfully solved by Lallemont, a Frenchman, who hung cranks to the front axle of the modified form of the hobby-horse, so that the machine could be propelled entirely by the feet and steered by the hands. Lallemont's machine, the original "bone-shaker," was exhibited by his employer, M. Michaux, at the Paris Exposition in 1865, but little attention was attracted by the improvement in driving-gear. The next year, however, Lallemont worked his passage to America, where he at once built a wheel, and aroused considerable interest by riding it through the streets of New Haven. In November, 1866, a joint patent was granted to Lallemont and Carrol, and this is the first one in the United States showing the two-wheeled velocipede with foot-cranks—in fact, the first complete patent actually obtained anywhere for such a machine.

This vehicle consisted of two wooden wheels, of nearly equal size, one before the other, shod with iron tires and surmounted by a wooden perch, from which projected downward, near its rear end, two arms on either side of the rear wheel, each pair of arms meeting at the end of the hub and forming a bearing for the axle. A similar device projected from the fore end of the perch on either side the forward wheel, furnishing bearings for its axle, and arranged with a pivot in the perch near the upper end, so that, by means of a handle-bar above, the front wheel could be turned to the right or left in

steering the machine. The perch was curved downward in the middle part, and from a joint near the front forks, backward to a joint over the rear wheel, extended a straight steel spring bearing a saddle about midway between and above the two wheels. From this position the rider could place his feet upon the balanced pedals on the cranks connected with the front axle, the latter being fixed in the wheel. Thus seated, he started the machine in motion with his feet on the ground, and then put them on the pedals and propelled it. This was certainly a better contrivance than any other yet brought out, but, at best, it was clumsy and awkward, and lacked the important features which were essential for the success of a practical road vehicle. The application of power was disadvantageous, as the thrust, instead of being directly downward, was forward and down. It required several times as much propelling force as is used on the modern bicycle. Historically it is a rare curio, and as such is preserved in the collection owned by the Pope Manufacturing Company.

The popularity of the velocipede in America reached its height about 1869 or 1870, and the makers who had gone into this line of work had all they could do to supply the demands of the trade. The "Velocipedist," a journal devoted exclusively to the new interests, was issued, and a book written on the sport; and yet—so suddenly come the changes of public sentiment—two years later these machines had entirely disappeared, save here and there one in the hands of a boy. The reason for this short-lived popularity was the fact that the carriage builders who put out these wheels neglected to use proper bearings and such other devices as would have made riding more easy and enjoyable. Some steps looking to improvement in this direction were taken, however. C. K. Bradford, an American, had suggested the use of rubber tires, and experiments were tried with larger front wheels and antifriction bearings. In point of fact, one of our carriage manufacturers made velocipedes of a type similar to the high or ordinary bicycle, but the improvements came too late to save the trade, so that in 1870 he was caught with his store-rooms well stocked with these wheels, and no market for the goods.

The Franco-Prussian War retarded for a time the progress of cycling interests in France, though during that period there was a slow and steady growth in England, and the United States Patent Office reports show that our inventors were earnestly endeavoring to solve the problem. Meanwhile the use of wood gradually disappeared, giving place to wire spokes, steel hubs and felloes, and the tubular backbone, handle-bars, and forks. The round contractile rubber tire, too, came to be used in place of steel, and added materially to the comfort and ease of riding.

The first bicycles seen by me were some English machines shown at the Centennial Exhibition in Philadelphia in 1876. They attracted my attention to such an extent that I paid many visits to this exhibit, studying carefully both the general plan and the details of construction, and wondering if any but trained gymnasts could master so strange and apparently unsteady a mount. Some eight years had passed since the velocipede had excited interest in man-motor vehicles. This cumbersome machine, which had failed of success and gone out of use, because it was wrong in design and poorly constructed, had yet served a purpose in awakening the desire to possess a light and easy running mount suitable for every-day road service, and it naturally followed that many of the early devotees of the bicycle were men who had enjoyed a foretaste of its pleasures in riding the old bone-shakers.

The sport had by this time become more or less popular in England, and early in 1877 I had a bicycle constructed under the personal supervision of an English gentleman who was a guest at my house. This wheel, completed in August, was made entirely by hand, and cost the somewhat extravagant sum of $313. As soon as the machine was mastered I became so interested in it that I at once took active steps toward introducing wheels in America. The Pope Manufacturing Company had already been organized, and in September, 1877, an order was sent to England for a small quantity of bicycles, which were received late in that year. The initiative step in this great industry, however, was an order for the construction of the first fifty Columbias. It was given to the Weed Sewing-Machine Company, of Hartford, Conn., in the spring of 1878. During that season we marketed all told ninety-two wheels.

A trip to England and a careful review of the field abroad confirmed me in the opinion that this line of manufacture could be made profitable in the United States, and that Americans could be brought to look upon wheeling without unfavorable prejudice. The wheels seen at the Centennial Exhibition had been turned over to a Baltimore firm, who imported a few more, but soon went out of the business. Interest having been aroused, however, importers appeared in the market, and some years subsequent to our beginning to make wheels other companies were organized and took up the manufacture of bicycles; but from an historic point of view it is of

interest to note that the Pope Manufacturing Company is the sole survivor of all the concerns started during the first few years.

As soon as the possibility of the industry being pushed to success was realized, owners of patents became aggressive in their demands, so that, at the inception, the manufacture of bicycles was threatened with financial disaster. It was at this point that we adopted the policy of purchasing outright whatever patents proved to be valid and of value; or, if this was impossible, we took licenses. In this way a control of the business was secured, the industry was practically protected, and we were enabled to go on with the work and license others to manufacture under our rights. It became necessary, also, at the outset, to educate the people to the advantage of this invigorating sport, and, with this end in view, the best literature that was to be had on the subject was gratuitously distributed. At first the prejudice against the bicycle was so intolerant that its use was prohibited in many parks and public thoroughfares; and it cost many thousands of dollars to carry through the cases which resulted in the courts classing the bicycle as a vehicle, and granting to wheelmen the same privileges that were enjoyed by the users of carriages and other vehicles. We spent over $8000 in the Central Park case alone.

During the life of the ordinary or high bicycle, wheeling was a sport, pure and simple, and the trade was pushed practically to its ultimate limit, as the demand was naturally confined to those brave men whose courage and love of the sport could not be dampened by an occasional header. With the advent of the safety those of maturer age and more timid temperament gradually took up the exercise, and their enthusiasm, backed by its beneficial results, added thousands of new riders to the list of wheelmen.

The first safeties were necessarily heavy,—fifty pounds or more,—and, equipped with solid rubber tires, were not particularly comfortable. The next step in the development, therefore, was the adoption of the cushion tire, which, with the spring frame, so lessened the jar of riding over uneven surfaces that the weight of the machine could be reduced. The comfort thus secured broadened the demand. Then came the introduction and perfection of the pneumatic tire, which did away with the jars to such an extent that the manufacturer could with safety again decrease the weight, thus adding greatly to the speed and practical utility of the wheel as a means of easy transit.

With added years of experience the manufacturers have scientifically developed the bicycle as a whole, and put into use hundreds of devices in the detail of its construction. The results are seen in the wonderful wheels of to-day, ranging in weight from seventeen to twenty-four pounds. Wheeling can now be enjoyed by young or old; any one who is able to walk has the strength necessary to propel the bicycle. Furthermore, as the demand increased, makers of medium-grade bicycles came into the field, putting out machines for boys and girls, as well as for men and women, so that now bicycles are practically within reach of even the most moderate means. The cardinal points of development noted above show quite clearly the reason for the increased use of bicycles, and the way in which the field has been broadened, starting with daring young men and ending in the adoption of the wheel by all classes and conditions of mankind. From the outset many doctors have believed in and recommended the use of the bicycle, and now practically all physicians indorse wheeling as one of the best and most health-giving of outdoor sports.

As an industry the manufacture of bicycles is very important. There are now about 200 of these concerns in the United States, many of them large and substantial companies, representing in the aggregate an investment of $20,000,000, exclusive of those who devote their attention to making and marketing accessories. There are 25,000 men engaged in this line of work, and as many more in distributing the product. The center of the best bicycle manufacturing is in the Connecticut Valley. The Pope Manufacturing Company alone employs a force of over 2500 men, and has, in addition to this, branch houses in the large cities and 3000 agencies throughout the entire country.

Early in 1893 a bicycle insurance company, carefully reviewing the field for data on which to estimate chances of loss, concluded that there were in use at that time in the United States not less than 1,000,000 wheels. A very reliable estimate of the product for 1895 puts the number of bicycles at about 550,000, and present prospects indicate that at least fifty per cent. more will be made and sold in 1896.

As the success of one leading merchant assists hundreds of smaller concerns, so the healthy development of a new industry is of material advantage to those who supply the increased demand in special lines. The perfection of the bicycle has opened a large market for steel and rubber, has resulted in revolutionizing the methods of drawing seamless steel tubes, and has wonderfully improved the man-

ufacture of rubber goods. Instead of importing tubing from England, as was done in the early days of the trade, this product is now supplied by American makers, and some of it for the purpose is better than any other tubing now known. It took years to advance from the old-fashioned solid-rubber tire to the single-tube tire of to-day. This one line of development has cost a great deal of money, both in the way of experimentation and in the equipment of plants. There are hundreds of patent devices covering tires, and the methods of attaching them to the felloes of the wheel. A cardinal point of interest to the trade is the fact that a few years of actual use have so changed the public demand that the single-tube tire is now called for by about ninety per cent. of the riders. In addition to these important branches there have grown up side by side with the bicycle industry such profitable lines as the manufacture of saddles, lanterns, bells, costumes, and all the other articles classed under the term "accessories."

The inception of the agitation for good roads was coincident with and started by my early bicycle experience on the suburban roads about Boston. Pioneer work cost high, in both time and money, and though at first it seemed a thankless undertaking to reform the road management throughout the country, recognition was finally obtained as the result of constant attacks on the old system through addresses before meetings of the Carriage-Builders' National Association, Chambers of Commerce, and other assemblies of representative men, as well as by a liberal distribution of pamphlets, and contributions to the press.

At the first meeting of the League of American Wheelmen we took a decided stand on this subject, and urged the advisability of the organization working unitedly for this reform. To-day all wheelmen are earnest advocates for good roads, and much of the success already attained is due to their hearty coöperation and support. To comprehend the financial advantage of good roads one has but to consider that there are throughout the United States over 1,000,000 miles of highways, and that a saving of a few cents per mile in hauling produce to and from the railway stations and shipping points would in one year mount up to a sum sufficient for the construction of a majority of the roads now needed east of the Mississippi River. The increased valuation of property caused by the construction of good roads is well illustrated in Union County, New Jersey, where in one year property advanced $1,359,600. The legislatures of New Jersey and Massachusetts were the first to pass road laws which by actual experience have proved to be practicable.

On several occasions I had the honor to memorialize Congress, and once submitted a monster petition on the importance of this reform; and the national government formally recognized the public demand when, in 1893, a clause was introduced into the Agricultural Bill appropriating $10,000 to "enable the Secretary of Agriculture to make inquiries in regard to the system of road management throughout the United States, to make investigations in regard to the best method of road making, to prepare publications on this subject suitable for distribution, and to enable him to assist agricultural colleges and experimental stations in disseminating information on this subject." A special agent was put in charge of this work, and the information collected is being published in convenient tabulated form and freely distributed. Many of the States have followed the example of Massachusetts and New Jersey, while others are formulating plans with the view of adopting such legislative measures as will be most effective in improving the common ways of the various States.

It is believed that the United States will enlarge its work in this direction, thus in time making American highways second to none in the world. The plan followed by the Old Bay State commends itself because of the good work already accomplished. Massachusetts has a permanent Highway Commission, with the terms of office so arranged that two out of the three members will always be men familiar with the work in hand. Each commissioner receives a salary of $2000 a year, with an additional allowance for traveling and other necessary expenses. The State provides offices for the use of the commissioners, who can be freely consulted during certain hours by town and county commissioners and others having the supervision of road construction. The original enactment has been so modified that, instead of petitioning the legislature for the construction of each highway, a large sum is appropriated annually to be expended at the discretion of the commission. As each section of State road is intended to be an object-lesson in road construction, wisdom has been shown in distributing the work throughout the entire State by building here and there small portions of an elaborate system which, when completed, will furnish an excellent means of communication throughout the commonwealth, and, joining with through roads in other States, will facilitate interstate traffic. Every-

thing is done in the most systematic manner, and there is being collected a valuable amount of data bearing on the rock deposit suitable for road construction and repair. As this work progresses, sectional topographical maps are being published, showing the exact location of all materials suitable and available for work on the public highways.

The advent of the motor-carriage is bound to increase the interest in good roads. The day of the horse is already beginning to wane, and as soon as a practical motor-carriage can be had by men of moderate means we must have good roads, not only in and about the cities, but throughout the entire country.

Albert A. Pope

CHAPTER LXXXV

THE DRY-GOODS TRADE

IN the beginning of the century the dry-goods trade of this country presented but few features of interest. Indeed, textiles were so often combined with other commodities to form the merchant's stock in trade, that it was difficult to determine where the former began or the latter ended. Trading of all kinds was of a generalized character, merchants handling alike dry-goods, groceries, and sundries in the same establishments. The stocks represented in such stores were incongruous in the extreme; cottons and silks from India, and velvets and woolens from Europe, were placed in juxtaposition with groceries and hardware.

The trade in textiles in those early days was almost entirely of an import character, and the wholesale merchants, as a class, were either directly or indirectly importers. The extent of American cloth manufacture, as a factor in commerce, was inconsiderable. There were then but few specialized industries or departments in trade or traffic, as we now understand such distinctions. The distaff, the spinning-wheel, and the hand-loom were part and parcel of nearly every well-regulated household. The flax and the wool were raised, carded, spun, and woven at home, and the same hands that performed these offices also frequently fashioned the fabrics into wearing apparel for the use of the family. This state of things, as a matter of course, applied more fully to the common people. The rich or more prosperous classes of the community then, as now, imported many of the articles which formed their wardrobes, as well as their bed and table linen. Comparatively little attention was given to the culture of cotton at this period by the American people, and its use in the household, in connection with wool and flax, was by no means general. Its manufacture in an organized way, like wool, was confined to one or two establishments of crude construction and operation. They produced fabrics of no great commercial importance, save that they served to mark the initial stage or starting-point for the greater multiplication and diversification which have followed.

When it is considered that the inventions of Hargreaves, Arkwright, Paul, Crompton, and Cartwright had barely been adopted in this country at the close of the eighteenth century, the development of our textile industries since has been simply marvelous. At the time referred to, our home products, in an organized way, represented, in woolens, a few coarse cloths; in silks, a few lace and braid sundries; and in linens, some coarse sheeting and toweling. Our imports of foreign textiles during the same period were also of moderate proportions, being probably about double the value of the home product. In fact, from the close of the Revolutionary War until 1795, our imports of foreign dry-goods averaged yearly about $24,000,000 to $26,000,000, while the value of the home product varied between $12,000,000 and $13,000,000. The latter, being almost wholly of household manufacture, had but little representation in merchants' stocks.

The village stores in those early days were few and far between, and where they did find location, their stocks, so far as dry-goods were concerned, represented only a few of the coarser textures in woolens, linens, and cottons, with buttons and thread, associated with goodly supplies of rum, molasses, and groceries. A considerable trade with towns located on the banks of inland streams was transacted by means of flatboats similarly stocked. In the cities the wholesale trade was almost entirely confined to the importers, who dealt in those foreign and home commodities, crude or manufactured, which were in the greatest demand and yielded the best profits. With the retail trade in the cities likewise, the distinction in the kind of goods handled by different dealers was not very marked, most of the shopkeepers selling a little of everything. In some of the larger cities, however, a slight tendency

toward separate classification began to appear; that is, dry-goods and notions, in the more pretentious establishments, were to some extent sold to the exclusion of other commodities. But the general condition of the people—the fact that they supplied themselves with the manufactures of the household, and preferred in many cases to barter rather than pay the cash—did not tend to develop early any very large retail establishments in separate lines of goods, even in the most populous cities.

In this connection it may be interesting to note that the imports of foreign merchandise paying ad valorem duties into the United States from 1795 to 1800 inclusive, amounted to nearly $212,000,000, of which the textile part represented about two thirds. The kind and character of the latter—especially at New York, which was then, as now, the chief importing city of the country—may be readily inferred from the following names, given in the orthography of the day. They represented goods chiefly from India and China, and the cities of Amsterdam, Hamburg, Liverpool, and London, such as cottons, woolens, silks, velvets, linens, laces, edgings, hosiery, gloves, and shawls, including damasks, dimities, callimancoes, durants, tabarets, platillas, listadoes, mamoodies, gurrahs, cossas, baftas, russets, satinets, duffels, britannias, etc. Among the more important firms in New York importing or handling such goods about 1800 were: Bethune & Smith, Murray's Wharf; John Knox, 97 Water Street; McCready & Reid, 97 William Street; Hector & Scott, 125 Pearl Street; John & William Tabele, 260 Pearl Street; Richard & John Thorne, 141 Pearl Street; Benjamin I. Moore, 103 William Street; Charles J. Vogel & Company, 92 Maiden Lane; William Blackstock & Company, 163 Pearl Street; A. S. Norwood, 127 William Street; Robert & John Sharp, 93 Maiden Lane. These firms, with the exception of A. S. Norwood, who dealt almost exclusively in carpets, rugs, and bedsides, handled dry-goods more largely, perhaps, than other houses, although among the latter, who sold them in connection with other foreign and domestic commodities, might be mentioned: Archibald Gracie, 52 Pine Street; James Stuart, 10 William Street; Eben Watson & Company, 36 Old Slip; Fergurson & Crichton, 84 Broadway; Rogers & Lambert, 232 Pearl Street; H. G. Rutgers & Company, 145 Pearl Street; Rutgers, Seaman & Ogden, 93 Front Street; Thomas Bulkley, 241 Front Street; Suydam & Wyckoff, 21 South Street; Robert Weir & Company, 16 Gold Street; John Knox, 97 Water Street; Thomas Warren, 61 Maiden Lane; John MacGregor, 84 Broadway; and Minturn & Barker, Thomas Napier & Company, Robert Lenox, Frederic de Peyster, Gouverneur & Kemble, John Murray & Sons, and others.

From 1800 to 1815 the country, its trade and industries, passed through some very trying ordeals—complications arising with France, the Embargo and Non-Intervention acts going into effect, and everything finally culminating in the war with Great Britain. The restrictions upon our import trade during this period tended rather to foster our home industries than otherwise. In 1803 a serious panic prevailed in Great Britain, which materially affected our trade interests both at home and abroad. In 1804 the first consignment, for sale, of American cottons was made by Almy & Brown, of Providence, R. I., to Elijah Warren, of Philadelphia, Pa., who became their agent for yarns and threads, and afterward for stripes, plaids, checks, ginghams, tickings, etc. The amount of domestic cottons sold in Philadelphia, the produce of New England factories, from 1804 to 1806 inclusive amounted to only $17,670.

The Embargo went into force in 1807, and as a matter of course, almost wholly cut off our foreign trade. The cotton-spindles in the United States at this date amounted to about 4000, showing that the progress made in this line of industry had been slow, although before the end of the year they had doubled, and by 1809, seventeen mills were in operation in Providence, R. I., and vicinity, working 2296 spindles, and producing about 510,000 pounds of yarn. About 1000 looms were employed in weaving cotton cloth. The census returns for 1810 also gave further evidence of more or less rapid advancement being made in the manufacture of cottons and woolens, as well as in other industries. In round figures, according to the Treasury Department, the value of our product in cottons and woolens, exclusive of clothing and other goods, in 1810 was nominally about $46,000,000. The invention of the cotton-gin by Eli Whitney in 1794 had brought about a great change in both the production and the manufacture of cotton, so that from this time forward it became our leading textile product.

In the years 1815–16 our imports of foreign dry-goods were so enormous as not only to glut our markets, but to paralyze our cotton and woolen industries as well. In fact, many of the leading importing and other merchants of the time were almost ruined by the unprecedented fall in the prices of goods and the general stagnation of trade and business resulting. This state of affairs was not entirely due to the results of the war, and the reopening of

our ports to foreign traders who took advantage of the low rates of the ad valorem duties then prevailing, but was caused largely by the cotton and woolen manufacturers of Great Britain who unloaded their surplus stocks in our markets at prices below the cost of production, with the view to cripple our textile mills and control the trade of this country. In this they succeeded for the time being and for some years later. From this period onward, through the decades ending with 1820, 1830, 1840, and 1850, there is but little reliable official information to be gleaned from the census reports respecting our advancement in manufactures, if the year 1850 be excepted; but that it was gradual and steady is evidenced by the increased production of the spindles and the looms, especially in cottons and woolens, distributed by the general dry-goods trade. Our imports of textiles also kept growing apace, but not in like ratio to those of home production. This long period was eminently one of preparation and organization for both our dry-goods and our general textile-manufacturing interests. Many important inventions and processes were perfected during this time, such as the sewing-machine, power-loom, knitting-machine, and other mechanical devices, which not only changed but multiplied and diversified the textile manufactured products of the world, and thus created many of the subdivisions which are such important factors in the dry-goods trade to-day.

The wars, panics, depressions, conflagrations, and other vicissitudes through which the trade and country passed in the first half of the century seemed to spur manufacturers and merchants to make renewed efforts in the upbuilding of our industries. In the latter decade of it there set in a more marked tendency toward the diversification of products, and the inauguration of improved methods in their sale and distribution. The classification of goods was then carried to a much finer point than formerly, and the general trade, both wholesale and retail, outside of the regular dry-goods jobbing houses, began to make more or less separate distinctions in the goods which it sold. There were importers and wholesale dealers who handled special or distinct lines of goods, as silks and dress-goods; cloths, coatings, and cassimeres; notions and small wares; hosiery, underwear, and gloves; laces and embroideries; white goods and linens; and hats and caps. In the retail trade in the cities these distinctions, in many cases, were equally well outlined, although the stores in the larger towns and villages throughout the country still adhered more or less closely to the original policy of carrying miscellaneous stocks of merchandise. The evolution of the clothing trade, and, still later, that of made-up articles for women's and children's wear, not only brought the immigrant garment workers to the front in these particular lines of trade, but also, in the succeeding decades, made the classifications in manufacturing, wholesale, and retail circles still more minute and numerous. If there be added to these the development and more general utilization of the commercial agency and the commercial traveler systems, we have the grand factors which are so potential in the extension and prosperity of the dry-goods trade of to-day. Indeed, when the year 1850 dawned we had reached the basis on which to build a broader national and industrial development. With the founding of new towns and cities in the interior, West and South, there came a larger and more diversified demand, with an increase of stores and shops, while newer and more varied articles of merchandise, suitable to the growing wants and tastes of the people, were being produced. In 1850 the value of our cotton and woolen products aggregated about $112,000,000, while our combined textile output reached $129,000,000. Our imports of foreign dry-goods for the same year approximated $59,000,000. As compared with 1795, the former had increased about tenfold, while the latter had only about doubled. However, this is not altogether a fair showing, for the reason that the dry-goods trade, both wholesale and retail, then, as now, handled large quantities of miscellaneous merchandise not strictly included in the textile class, but which, if enumerated in value, would largely swell the total in sales, and make the increase in general distribution for the fifty-five years the more noteworthy and significant.

Thus it will be seen from the foregoing, that the year 1850 marked a new era in the history of the dry-goods trade of this country. Prior to it there was practically no domestic commission business done in New York City. Boston, Philadelphia, and Baltimore were then the domestic commission centers. The product of the New England mills was mostly controlled by Boston houses. Philadelphia had twenty or more commission-houses selling all kinds of domestic goods, and it was the chief market for what were then designated as "blue goods," which comprised denims, checks, stripes, etc. Some of the Philadelphia houses were organized as early as 1832. About this time, also, a large quantity of dry-goods were sold in Hartford, Conn. New York was the market of this country for imported goods, and the importance of opening domestic commis-

John N. Beach.

sion-houses in that city then began to be recognized. At first the Boston merchants, who were the agents of the Eastern mills, discouraged the project, and only a few of them were induced to open small offices in New York. Soon, however, it was found that in these small offices a larger business was being done than in the parent houses in the East, and so one house after another, and mill after mill, opened agencies in New York for the sale of the goods represented or manufactured by them, and the business soon developed into extensive proportions. At this date the jobbing business of New York was still largely done downtown, on Broadway, Cedar, Pine, Liberty, and Broad streets; there were no retail houses above Howard Street. Our home manufactures of textiles were still mostly of a common staple character, all the finer goods being imported from Europe.

In 1857 occurred the memorable panic, which for the time paralyzed the business of the country; and the dry-goods interest, being the largest and most diversified, suffered the most severely. A daily record of one of our New York houses, kept continuously from 1847 to the present time, notes August 27, 1857, "the failure of the Ohio Loan and Trust Company, as the beginning of horrors." October of that year is recalled by all who took part in the struggle as a time which tried men's souls —and their bank-accounts. Numerous failures occurred, and many were the accounts of fortunate turns and of hairbreadth escapes from suspension and failure.

The imports of foreign dry-goods into the United States in 1860 amounted to $112,350,000, while the value of our combined textile manufactures reached $215,000,000. As contrasted with 1795, the former had increased nearly fivefold, and the latter nearly eighteen times. The war between the North and South succeeding, it may be interesting to particularize some of the more important commercial and financial events that ensued, and which specially affected our dry-goods interests. In December, 1861, cotton goods began to advance, and the average increase in prices during the first two years of the war was about 300 per cent. The following year showed a still sharper rise, and the high prices of the war culminated in the fall of 1864, when the average advance in prices of cotton goods from December, 1861, was about 1000 per cent. In April, 1864, raw cotton sold at $1.90 per pound, and on July 11th gold reached 299. The period intervening between 1861 and 1864 was one of the sternest trials the mercantile world has ever known. In Europe it was known as the "cotton famine," regular shipments of the staple from the United States being almost entirely suspended. General Lee's surrender occurred April 9, 1865, and on June 30th of that year cotton sold at forty cents per pound. Manufactured cottons, however, did not show proportionate decrease in price. In October following cotton had risen to sixty-four cents per pound, while prints, sheetings, etc., were about half the price which had been current for them in the fall of 1864. It was during this year that the largest dry-goods jobbing house not only in this country, but in the world, distributed goods broadcast throughout the Union to the enormous amount of $72,000,000. Turning again to our imports of foreign dry-goods and the home manufactures of textiles, we find that the former in 1870 aggregated only $98,290,000, while the value of the combined product of the latter exceeded $520,000,000. The increase, as compared with 1795, in imports was barely fourfold, while in home products it represented about 2500 per cent.

From this date vast strides were made in the character and scope of our domestic manufactures. The rapid increase in immigration, the development of the great Northwest, causing an enlarged demand for dry-goods, were met by our manufacturers with largely increased and improved facilities for producing them. A special impetus was also given to the production of the finer and better grades and more varied styles of merchandise by the Centennial Exhibition of 1876. Our people then began to realize what could be done in this country.

By 1880 the value of our textile products was nearly $533,000,000, while our imports of foreign dry-goods approximated to $136,000,000. The showing in this decade for the former, as compared with 1870, did not exhibit a very large increase; still it must be borne in mind that our manufacturers encountered some very severe vicissitudes during this period, and besides, from the close of the war onward, there had been a gradual and steady decline in the prices of nearly all kinds and classes of textiles, due to the improving and cheapening of facilities for production. While the value of the output showed but little appreciable augmentation, the increase in quantity and variety was especially noteworthy. From 1881 to 1887 inclusive, Mulhall, one of the most reliable of foreign statisticians, estimates the aggregate value of the output of American textile manufactures at $3,250,000,000, which would give an annual average value for the seven years of $465,000,000. But he was consider-

ably below the mark in his figures, since the output three years later (1890), according to the census reports, represented nearly $722,000,000. This large amount, added to our imports of foreign dry-goods for the same year,—nearly $156,000,000,—made the grand total of $878,000,000 of textiles imported from abroad and produced at home. Compared with 1795, this shows an increase of nearly 4600 per cent. The home manufactures alone show a gain of over 5500 per cent., while the imports exhibit a gain of less than 170 per cent. On the basis of an increase of at least fifteen per cent. from 1890 to 1895 in the value of the product of our textile manufactures, it would make the same approximate in the latter year to $830,000,000, which, if added to the imports of foreign dry-goods for the fiscal year ending June 30th,—$137,000,000,—would swell the grand total of textile manufactures for sale or distribution to $967,000,000. However, the foregoing estimates do not include the freight, insurance, duties, etc., on foreign dry-goods, nor the sellers' profits on the same, as well as on domestic goods. If all these be added, the annual aggregate value of textiles alone handled by the dry-goods trade of the United States to-day would largely exceed $1,000,000,000.

We have now the final comparison of 1795, with $40,000,000, and of 1895, with nearly $1,000,000,000, to show the growth and the development of the dry-goods business of the country for the century. This would give the ratio of increase for the one hundred years as about 4000 per cent. This is wonderful, considering all things. But textiles only have so far been considered, while the dry-goods merchant of to-day, both wholesale and retail, handles multitudes of articles not included in that category which serve to increase his sales to a very large extent. Owing to the great subdivisions now existing in the trade, as well as to the fact that the large commission-houses, importers, jobbers, and retailers have intermixed dry-goods proper with many other lines of merchandise, it is utterly impossible to get at the exact value of the annual distribution. In fact, in the later decades of the century there has been a manifest disposition on the part of the large retail houses in our cities and more enterprising towns to buy and sell, like the early importers, promiscuous merchandise and wares in connection with dry and fancy goods proper. The census reports of the United States have divided the manufacturing industries into 363 classes, of which the dry-goods establishments of the present day contain not less than one sixth of the whole. In many of these stores are to be found nearly all the modern appointments and conveniences that serve to attract, please, and satisfy the wants of customers. The refectories, cash, delivery, sample, mailing, and express systems are now some of the more prominent features of some of these establishments, which have patrons living thousands of miles away that perhaps never visit the store, having their wants as efficiently attended to as those living nearer at hand.

While the retail branches of the trade have grown apace, the wholesale departments have not lagged behind. The older importing and jobbing centers still maintain their due share of the country's trade, but it is nevertheless centralized in fewer houses. The gain in trade and traffic by interior, Western, and Southern distributing centers represents no very material loss to the older Eastern cities, from the fact that there has been in many instances such an unprecedented increase in the wants of the people of those sections, due to growth of population, geographical and other reasons, that the organization of wholesale distributing houses there became a necessity. An estimate of the textiles manufactured in this country during the past century, based upon the United States census reports and upon the figures of reliable statisticians, would place the aggregate value of the same at over $20,000,000,000, while the imports of foreign dry-goods for the same period would probably represent one third of that amount, or nearly $7,000,000,000. Adding to this total of $27,000,000,000, the freight, insurance, exchange, and duties on the foreign part, and the sellers' profit on the whole amount as the goods reach the consumer, we would have the enormous aggregate of nearly $40,000,000,000.

The merchants of America who have handled the immense quantity of merchandise instanced have, as a rule, been men who have borne favorable comparison with those in other varied walks of life. A standard of integrity and honor was formed by the early merchants, which their successors have maintained. Before the days of "rapid transit," when a journey from Buffalo to New York was more of an undertaking than is now a trip to California or to Europe, the village merchant who made his annual or semi-annual visit to the city was the oracle of his neighborhood. His return home was hailed as an important event. He was immediately surrounded by his neighbors, anxious to hear all the news from the city. The answer as to whether goods were "high or low" settled the market with them for the season, as "new goods" would not again make their appearance for six months at least.

Those who were in a position to secure the first selections were to be congratulated. After the advent of new goods ceased to attract attention the merchant would find time to attend to certain duties which, by virtue of his position in the community, were apt to be placed upon him. As a rule, he held the office of postmaster, town clerk, school trustee, and exchange banker, for his customers. He wrote their wills, and in due time executed many of them.

Numbers of such old-time retail merchants can now be recalled by our city jobbers. They were, in the main, honest men—as is true of the great majority of the merchants of to-day. While dishonest failures occur, and always have, and always will, they are the exception and not the rule. The safety with which wholesale merchants distribute millions upon millions of dollars of merchandise far and near, throughout the length and breadth of this land, lies essentially in the fact that they are dealing with honest men, whose ambition is to make themselves more and more worthy of credit. Mutual confidence exists, and forms the basis of the immense volume of business of the present day. The aggregate transactions of a single day in any of our large houses often reach hundreds of thousands of dollars, and many of them are based upon the simple word of honor. A prominent dry-goods merchant, accustomed to large offhand transactions with his fellow-merchants, was recently closing up a real-estate deal. Being somewhat wearied with red-tape delays and repetitions, he exclaimed, "I suppose all this is necessary with you real-estate people; but in my office I would have transacted ten times this amount of business, with perhaps not a written word between my customer and myself, and our obligations to each other would have been carried out as faithfully as will these which you have taken volumes to express."

In the early days of mercantile paper, and not very far back in the century, a banker said to a dry-goods merchant, "Where is your collateral upon which you ask for this loan?" The merchant, with becoming dignity, replied, "My collateral is in my warehouses, upon the pages of my ledger, and in my bank-account. These constitute my ability to pay, and you must have faith in my simple promise to do so." Faith thus wisely placed is not very often betrayed, and commercial paper has become a safe and favorite means of investment. A leading member of the New York bar, upon a recent visit to one of our large dry-goods establishments, was greatly surprised, and expressed it as "a new revelation" to him, that thousands of packages of merchandise were shown him, the contents of which had never been examined since they left the mills, and would, without examination, be shipped in every direction, some of them thousands of miles distant, with the minimum risk that they would fail to conform to the invoice or that unjust claims would be made against them. Transactions of this character are enormous, and are made with safety. The present facilities for finding out the correct standing of "far-away merchants," not only as to their financial ability, but also as to their moral character, business habits, and general reputation, are so good that in adjusting credits space is in a great measure eliminated.

Since the establishment of the first mercantile agency in 1841, these agencies have multiplied and improved so as to be of vast service in determining credits. While far from infallible, they are indispensable. The uniform courtesy existing between merchants in the exchange of references is also of great value, and with all the means of information now at hand the "far-off merchant" worthy of credit suffers no disadvantage by reason of distance from market. While rivalries exist, and rightly so, between merchants and between cities, it is worthy of note that petty jealousies are rapidly fading away. The development of this country is so great, and the interests of the people are so closely allied to one another, that anything affecting one part of the country affects the whole, and sectional differences and strifes are rapidly disappearing. The constant growth of this country in population and wealth, and in the legitimate means of obtaining the latter, has a broadening influence upon the people. With our enormous immigration, reaching as high as 750,000 in a single year; with the admission of five States into the Union within the past five years, having an area exceeding that of Germany, France, Great Britain, Ireland, Belgium, and Holland combined; and with four Territories yet to be admitted, equaling the area of the United States in 1800, the industrial and commercial interests of this country must continue to make rapid strides forward, and the dry-goods trade will not fail to maintain its prominence as the chief distributing industry of the country.

In point of capital and labor employed, and magnitude of proportions, it has no equal. The tendency of this country to concentrate and to centralize business interests applies to the dry-goods trade in a very marked degree. The business is being more and more merged into large establish-

ments. The present number of dry-goods houses in New York, for example, falls far below that of twenty-five or even fifty years ago; but the aggregate amount of merchandise sold there exceeds by far that in any previous period in the history of the city, and this notwithstanding the numerous large and important outlets which have since been added to the list. As an illustration of this it may be related that the head of one of the prominent dry-goods houses of New York, upon reaching his counting-room one morning since the "days of large things," opened the sales register, and proceeded to compare the sales of the preceding day with those of his first year in New York. Turning to one of his partners, he remarked, "It is rather a singular coincidence that the sales yesterday of this house exactly represent the aggregate sales of the first six months of its existence." This is but a single instance pointing to the fact that New York City, as well as the other older cities, maintains its supremacy as one of the great commercial centers of this country.

John N. Beach

CHAPTER LXXXVI

THE CLOTHING AND FURNISHING TRADE

THE history of the manufacture of ready-made clothing in the United States is comprehended in a period of perhaps seventy years. There do not appear to be any records of the earliest days of the trade, and its origin is lost in the obscurity of time. It is probable, however, that the cradle of this important industry, in which vast fortunes have been made and lost, was at New Bedford, Mass., where, so far as I can learn, the first ready-made clothing was manufactured to supply the immediate and pressing needs of the sailors returning from whaling voyages, or to stock their slop-chests for new adventures on the sea. These goods were of the coarsest materials, but they served the purpose. This first systematic attempt to make up clothing for immediate wear must have been at least as early as 1830, and it is possible that it was before that date. At the beginning of the century whose commercial history is comprehended in the present work, every man went to the draper, as he was called, for his raiment, as in England and in Europe generally he still does. Clothing ready to wear, according to our modern development of the idea, had not then been thought of. Whoever he was who first conceived the idea of ready-made clothing, though he left no name for posterity to honor, his invention was destined to have a great influence upon the industries of his day, and upon the commercial history of his country. Beginning in a small way by supplying returning sailors who could not wait for the usual slow processes of shears and goose, the demands increased so that presently many dealers found it expedient to make up in advance a small stock of garments, to meet a sudden, if not overcritical, demand. The idea reached Boston in due course, and then New York City, where the trade was stimulated, a few years later, by the requirements of emigrants to the newly discovered gold-fields of California. The business soon assumed a considerable importance, and the dealers began systematically to operate small factories on their premises.

In the earlier days the demand for ready-made clothing grew fastest in the West and South. In those then somewhat remote parts of the country there were not the facilities for manufacture that existed about the commercial centers of the East. The wholesale production of ready-made clothing here naturally followed. George Opdyke, once mayor of New York, was one of the earliest to engage in this business. About 1831 he commenced to manufacture clothing in Hudson Street, opening a store in New Orleans. Some three years later, his brother-in-law, John D. Scott, moved from Baptisttown, N. J., to this city, and took charge of the business of the factory, the firm being changed to John D. Scott & Company. They subsequently opened retail stores in Charleston and Memphis, which with the wholesale store were carried on until 1865, the firm being then dissolved by the death of Mr. Scott. They made their clothing of the coarser grades, largely for field hands in the South, but supplied the planters with garments of good quality. John T. Martin, who is still living in Brooklyn, went to St. Louis, where he did a very prosperous business in the days before the war, retiring upon a large fortune many years ago. Mr. Thomas Chatterton, still alive and hearty, began in New Haven as a dealer about 1840, and in 1846 he first handled ready-made clothing and entered the field as a manufacturer. In 1856 he came to New York, where his store was at 60 Liberty Street. It is interesting to note that he paid a rental for the whole building that he occupied of but $2800 a year. He afterward moved to Warren Street, the firm then being Lewis, Chatterton & Company. John H. Browning, the father of the writer of this article, commenced business in New York City in 1832 as a dry-goods jobber, under the firm name of Browning & Hull. In 1848 Mr. John H. Browning

started a branch store in California, making his first shipments mostly of dry-goods; but soon changed it into a clothing store and forwarded large amounts of cheap clothing, mostly gray flannel shirts and trousers for the use of the miners. The writer of this article commenced to take charge of the clothing department of his father's business in 1850, and remained with him until the spring of 1858, when he became associated with John E. Hanford, formerly of the firm of Lewis & Hanford, and engaged in the manufacture of clothing for the South and West. Their business was exceedingly prosperous until the breaking out of the war, when they had over $500,000 worth of assets in the Southern Confederacy confiscated. After the war broke out, the firm of Hanford & Browning, in the month of May, 1861, procured a contract from Quartermaster-General Thomas, of Philadelphia, for $1,250,000 worth of clothing, which in those days was considered a very large undertaking. After this large contract had been entered into and the cloth purchased from the mills, one Saturday afternoon the firm received a telegram from Quartermaster-General Meigs, of Washington, repeated by Quartermaster-General Thomas, of Philadelphia, which read:

"We understand you have awarded a contract to Hanford & Browning, of New York City, of $1,250,000 for army clothing. Is it possible? If so, stop it at once, as it is largely in excess of any possible demand.

"(Signed) Quartermaster Meigs."

John E. Hanford immediately started for Washington, and arrived there as our soldiers were returning from the unfortunate battle of Bull Run, and, on being admitted to Quartermaster-General Meigs's office, and with him going over the figures at which the contract was taken, the firm was again ordered to go ahead and supply the goods as quickly as possible. So rapid was the demand for army goods that cloth purchased for overcoats under that contract at seventy-six cents a yard, from Hunt & Tillinghast advanced to $1.50 a yard before the contract was completed. The original price to the government for the overcoats was $6, but the price had to be raised to $10. The firm of Hanford & Browning dissolved about 1862, and the business was conducted for the next three years under the firm name of Browning, Button & Kimball, and then changed to William C. Browning & Company, under which name it continued until 1868, when the present firm of Browning, King & Company was started. The house has retail stores to-day in fifteen cities, a wholesale house in Chicago, and a large factory in New York City.

It is impossible at this date to preserve anything like a chronological order in recalling the names of others of the early manufacturers whose operations developed the industry that to-day has attained such great proportions. But among them, as they are called to mind haphazard, were John T. Martin & Company, from whom, through a succession of changes, has sprung the present house of Rogers, Peet & Company, in which Mr. Martin is a special partner, and his son, William R. H. Martin, is a partner; Brooks Brothers, who started business at Catherine and Cherry streets in 1845, trading with the sailors along the water-front, and whose descendants still conduct the business at Broadway and Twenty-second Street; Lewis B. Brown & Company, who were in the Southern trade, and the head of which, having been forced under by the war, went into the real-estate business and founded the New Jersey summer resort called, in imitation of his own name, Elberon; A. T. Bruce & Company; Little, Pyan & Carhart, afterward, in 1862, becoming successively Schaeffer, Whitford & Company, Carhart, Whitford & Company, and, in more recent days, Hackett, Carhart & Company; H. & J. Paret; Daniel Devlin; C. T. Longstreet & Company; Archibald Young & Company; and Garrett, Young & Scott. Among other ante-bellum clothiers who have since achieved distinction in other fields of activity are the late Jesse Seligman, who began as a clothing dealer, then engaged in selling British dry-goods, and finally wound up in the banking business in Wall Street; and John J. Cisco, at one time assistant subtreasurer of New York. In those early days there was but a single Hebrew in the wholesale business; but a large number of Hebrews went to California as retailers of goods made in New York. They made a great deal of money, partly by the difference in exchange. Now the big wholesale business is largely in the hands of the Jews, as one may see by the bewildering array of signs in Broadway; while the retail business is largely in the hands of Christians.

The breaking out of the war caused great changes in the clothing business. Many New York manufacturers having a large trade with the South lost enormous sums, while others whose trade was in the West and North derived great benefits by the sudden demand for clothing in large quantities. Mr. John T. Martin and many others did a very large business in manufacturing uniforms for the government troops. These goods were made in the homes of the workmen at first, but afterward, as the

demands increased, factories were established, and the business was greatly stimulated. The unsettled conditions, due to the prolongation of the war and the depreciation of the certificates with which the government paid, made the business one of many hazards; but a few of the larger and more responsible dealers, having faith in the government, reaped their reward in the reëstablishment of credit and the corresponding appreciation of the government certificates from seventy or eighty cents to par. In the fall of 1865, when the war closed, the clothing business took its greatest jump, and the manufacturers were not able to supply the immediate demand for clothing for the soldiers returning home. Millions of dollars were spent for clothes that year.

The first circumstance to increase the powers of production to a point somewhat equaling the demand for cheap clothing was the introduction of the Singer sewing-machine about the year 1850. It was not regarded as wholly satisfactory at first, because machine-stitching would rip, and the hand-made garments were much firmer. The invention of the lock-stitch, remedying the principal fault, brought the machines into general use, and made possible the manufacture of the enormous volume of clothing used during the war. Previous to the invention of the sewing-machine clothing had of necessity been made by hand, and great quantities of it were sent out to the country towns round about New York, Boston, and Philadelphia, to be sewed by the wives and daughters of farmers and sailors through the winter. This clothing was used to supply the country trade, and was not as fine as that made in the cities; for, as a rule, the labor employed in the villages was cheap and unskilled.

It was not until some years after the war—perhaps about 1870—that cutting-machines were first introduced into the wholesale manufacture of clothing. The long knife was the first improvement upon the old-fashioned shears of former years, and this, operating something like a saw, made possible the cutting of some eighteen thicknesses of clothing to one thickness cut by shears. The Fenno and Worth cutting-machines came later, the blade being a circular disk, revolving rapidly, and cutting as many as twenty-four thicknesses of clothing with the speed and accuracy of a buzz-saw. By these modern agencies hundreds of suits can be cut and sewed by machinery in the time formerly required by the delving draper in fashioning a single garment. The ancient goose still holds its supremacy, however, as the only accepted implement for pressing garments, no improvements having suggested themselves in its form. Electricity has, however, taken the place of the furnace, in some instances, for heating the goose.

As the industry grew apace, and the number of persons to whom it gave employment increased, a certain method was naturally evolved, and a division of labor was arranged by which specialists in different details of the work of manufacture were developed. Formerly one tailor made a whole suit; now a dozen hands may be employed to advantage on a single garment. There is, first of all, the skilled designer, upon whose taste much depends in these *fin de siècle* days; the cutter, who in the best-regulated shops is a deft artist in his way; another sews certain parts of a garment only; there are vest makers and "hands on pants," as the phrase is; and still others make buttonholes, that difficult operation now being performed by machinery.

Clothing for boys developed separately and along its own lines. Smith & Davidson were among the earliest to devote themselves to children's garments. During the war the firm became Peck, Randolph & Smith, and in 1865 Mr. Smith went to Williamsburg and started the present house of Smith, Gray & Company. W. T. Runk & Company was another pioneer house in the manufacture of clothes for boys, and it continues to-day under the firm name of Hippel, Tillard & Runk, a son of the founder of the house perpetuating the name. Dayton & Gilbert were very large handlers of children's garments, and the house still survives as Dayton & Close. William Banks & Company, in Chambers Street, and Barrett & Schaeffer, in Murray Street, were also in the business up to the time of the war. Previously children's clothing had been made at home, as women's gowns are nowadays, by dressmakers.

With all these vast improvements in the methods of manufacture came a wider demand for clothing of higher grade, and at about the time of the close of the war persons of taste began to wear ready-made garments. A few leading houses in New York led the way, and, though progress was slow, little by little the early prejudice, founded upon the character of the "slop" clothes first introduced, was overcome. Men who had fancied that they could never wear "hand-me-downs," as they were vulgarly called, soon found that neither in respect of style nor materials was the best ready-made clothing inferior to the handiwork of the merchant tailor. That point being once made clear, there was a wonderful advance in the quality of goods manufactured, until to-day one can hardly fancy what an uphill road the early manufacturers traveled before the high quality of their wares was recognized. Now perhaps nine tenths of

the men and boys of the country wear clothing made ready to put on, and they are as well dressed as the other one in ten. The custom tailor still has, and I do not doubt will retain, a monopoly of those extreme fancies of the fashionable which justify their claims to exclusiveness. But the multitude is clothed by the clothier, not by the tailor, if that distinction be recognized. And if it be true, as I think it is, that the condition of a people is indicated by its clothing, America's place in the scale of civilized lands is a high one. We have provided not alone abundant clothing at a moderate cost for all classes of citizens, but we have given them at the same time that style and character in dress that is essential to the self-respect of a free, democratic people. In Europe no such advance has been made as yet, although a considerable quantity of ready-made clothing is manufactured in Germany, France, and England. They have not, however, progressed far beyond the point at which we started.

Statistically speaking, the figures of the trade are difficult of access. In 1860 there were 303 manufacturers in New York, making goods to the amount of $17,011,370; and there were 352 manufacturers in Philadelphia, producing goods worth $9,984,497. According to the Census Office reports we find that in 1890 woolen goods and worsteds manufactured in the United States amounted in value to $338,000,000, and cotton and silk manufactures respectively to $268,000,000 and $87,000,000. In the same year the importations of the materials reached $120,000,000, showing a consumption of more than $800,000,000. It is estimated that the value of clothing as sold to the people and made in part of these materials could not have been less than $1,500,000,000. More than three fourths of the woolen cloth made in this country is consumed in the manufacture of ready-made clothing, the remainder going to the individual merchant tailors. A considerable proportion of imported woolens is used also in goods of the better class.

The figures that follow are from the United States census returns for the five years indicated in the table. They present, more compactly than I could put the facts in any other form, a view of the extent and development of the clothing industry since 1850. It must be stated that the figures for 1850 include the clothing and tailoring trades together. Here is the summary:

PRODUCTION OF MEN'S GARMENTS.

Year.	Capital.	Wages.	Materials.	Products.
1850.	$12,509,161	$15,032,340	$25,730,258	$48,311,709
1860..	27,246,093	19,856,246	44,149,752	80,830,555
1870..	49,891,080	30,535,879	86,117,231	147,650,378
1880.	79,861,606	45,940,853	131,363,282	209,548,461
1890..	154,202,672	70,143,627	206,622,553	308,726,786

It was about the year 1870 that art entered definitely into the manufacture of clothing. Following the panic of 1873 there was a great increase in the patronage of the ready-made clothing dealers. At that time the quality of the goods made was raised, and the competition between the clothiers and tailors was more nearly on even terms.

The following table shows in what degree the business of manufacturing clothing has spread out over the country in recent years.

MANUFACTURE OF CLOTHING IN THE PRINCIPAL CITIES IN 1890.

	Number of Establishments.	Capital.	Wages.	Materials.	Products.
New York	1,554	$48,591,055	$22,548,892	$31,240,450	$68,630,780
Chicago	186	19,564,525	3,147,822	17,557,792	32,517,226
Philadelphia	222	17,561,257	4,631,991	12,318,810	21,103,220
Boston	191	15,792,768	3,311,837	10,916,407	19,672,404
Cincinnati	459	14,841,040	4,302,121	8,309,323	17,982,123
Baltimore	125	11,897,563	4,178,971	8,120,981	15,032,924
Rochester	199	7,488,446	1,644,334	5,172,185	9,538,962
Cleveland	24	1,618,178	868,179	2,431,169	3,972,392
Milwaukee	20	3,587,458	632,237	2,099,612	3,541,369
San Francisco	88	2,407,849	1,228,063	1,483,256	3,315,043
Utica	11	2,655,888	639,774	1,583,292	2,833,308
Buffalo	34	2,089,957	686,378	1,584,806	2,520,143
Newark, N. J.	93	1,251,287	850,945	774,831	2,485,395
Syracuse	92	2,422,392	588,379	708,400	1,776,500
Louisville	14	1,202,772	368,323	1,176,692	1,920,250
New Orleans	23	1,230,237	515,381	1,144,547	1,884,747

Of the furnishing-goods trade I can speak only at second-hand. In the year 1820 nearly all of New York's wholesale business was located in Pearl, Water, Cliff, and adjacent streets south from Fulton

William C. Browning.

Street; and William Street was the great thoroughfare of the New World metropolis—then a city of 120,000 inhabitants. Two years later, in 1822, was established the firm of Luke Davies, which later became Luke Davies & Son, and subsequently passed out of existence with the failure of their successors, Robert K. Davies & Company, in 1890. Mr. Luke Davies was not only the father of what has since grown to be a large branch of trade, but also the godfather, as he gave the industry its name of "furnishing goods." It was in a building at the corner of William and John streets that this firm had its rise. At that time traveling salesmen had not been invented, and the annual or semiannual visit of the country merchant to New York was an event for him,—and for the jobber,—for during the spring and fall seasons the rush of trade was enormous. Of the country buyers visiting New York, those from the East and North came by Long Island Sound or the North River on sloops or schooners. Over the wholesale and retail stores were boarding-houses where the country merchants stayed while buying goods. There were not many American manufacturers then, and nearly everything that one could wear was imported.

The origin of the men's furnishing trade began with the demand for custom shirts; and as the business of manufacturing shirts increased, other lines were added, as, for example, the making of "stocks" (for neckwear), suspenders, and jean underwear.

Out of the house of Luke Davies have come nearly all of the long-established houses now existing in the trade. In 1857 Joseph S. Lowrey left Davies to organize the firm of Lowrey, Donaldson & Company, which is now conducted under the firm name of Joseph S. Lowrey & Company; in 1867 Messrs. Fisk and Flagg also left the Davies establishment, and founded the present firm and business of Fisk, Clark & Flagg; and from these two branches have grown many of the firms which now control the largest lines in special departments in the manufacture of men's wear.

In 1832 the shirt trade of America was founded as a systematic industry by David & Isaac N. Judson, at that time prosperous clothing merchants in William Street. They had considerable trade with the South, —for in that day luxurious expenditure was mainly confined to that section,—and orders for clothing were frequently accompanied by orders for "custom-made" shirts, whose execution they intrusted to casual seamstresses. Orders for this class of goods increased steadily, and soon a regular department became necessary; and out of this grew the manufacture of "stock" shirts, in distinction to custom-made. What was incidental before 1832, in that year had become of sufficient importance to require a separate establishment, and the first shirt factory in America was founded at the corner of Cherry and Market streets, New York. The old building is standing yet, in a district not much altered by the passage of sixty years, and looking much as it did then, except for the change in the human surroundings that attends the expansion of a little city into a great metropolis. For eight years the Judsons were the only manufacturers of shirts. In 1840 the house of Davies established their factory, and the firm of T. A. Morison & Company also began operations, the latter firm still existing under the title of Hutchinson, Pierce & Company. The manufacture of each of the articles which are comprised in the aggregation known as men's furnishing goods has become a separate industry within the last decade, and the trade is now divided into many branches, of which shirts, collars and cuffs, underwear, neckwear, hosiery, etc., each forms a distinct industry, requiring special skill and special machinery in its manufacture.

It is interesting to recall the fact that the inventor of the Winchester firearms was one of the early manufacturers of shirts; and the circumstances under which he found himself in the business are curious. He was a carpenter in Baltimore, and had fitted up a furnishing-goods store there for a man who had previously failed. Mr. Winchester took the stock as security for his bill, and came to New York for advice as to the expediency of continuing the business himself. He went to New Haven in the early forties to open a shirt factory, and began with one assistant to cut out shirts. It was not long before he was turning out 2000 dozen a week. But Mr. Winchester was a restless genius, and with the outbreak of the war he turned his attention to firearms, and became interested in the manufacture of the weapon that has since made his name famous.

Wm. C. Browning

CHAPTER LXXXVII

THE BOOT AND SHOE TRADE

THE progress of the last century has brought a marvelous change to the "gentle craft" of St. Crispin. The huge, many-windowed factory has superseded the quaint little shop, and whirring wheels and busy machines have replaced the lap-stone, waxed thread, and awl of the old-time shoemaker. Everywhere there are changed methods; supply, manufacture, and demand have varied with the times and are now altered permanently. The only unchanged fact is that the children of men are born barefoot and must devise their own protection. History goes not back to the time when this need has not been recognized and met. The sandal of Greece and Rome, the sabot of the European peasant, the moccasin of the red man, the queer little stilts of Japan and China, as well as the footwear of our modern civilization, all show that the boot and shoe industry is founded on man's necessity—that the business is a legitimate one, and, when conducted with prudence, industry, and enterprise, should offer a fair return to men who have been trained to it.

The shoemaker was among the earliest of the craftsmen to seek the American colonies, and we find recorded in an old document, under date of 1629, that Thomas Beard, with "hides, both upper and bottom, was shipped out" on the *Mayflower*. The governor was recommended "to give him lodging and diet." Fifty acres of land were also allotted to him.

One Isaac Rickman is also mentioned as having been sent out at this time, but no further trace of him appears; whereas Thomas Beard arrived duly, is frequently mentioned in the chronicles of that day, and is undoubtedly the first in the great army of workers that has since raised Massachusetts to the industrial distinction of producing annually more footwear than any similar area of country in the world. Lynn, the "city of shoes," was a later settlement; Philip Kertland and Edmund Bridges arrived there as early as 1635 and worked at their trade of shoemaking.

In the years 1633, 1634, and 1635 we find Thomas Wardhall, Richard Scott, Angel Holland, Edmund Jackson, and James Everell shoemakers in the town of Boston. The latter was selectman from 1647 to 1649. Employing several journeymen, he built up a considerable business, including some foreign trade. He owned the property now bounded by Hanover, Elm, and Union streets. In 1641 the town authorities gave him permission to sink a pit, "so he cover the same," to water his leather in. He died in 1683, possessed of considerable wealth for the times. In consequence of his efforts Boston at that time took the lead in the manufacture of shoes.

William Copp, who owned Copp's Hill, carried on the business in 1640. In 1648 the General Court passed a law incorporating the "shewmakers" of Boston and vicinity, to regulate the trade, for three years. These and others like them manufactured in a small way, without much change during the next hundred years, making shoes to measure for the well-to-do, and a commoner article to be sold in the country stores. Many goods were imported from England; still the number of shoemakers increased with the population, and the production of ready-made footwear kept pace with the growth of the country, especially in Lynn, where in 1750 there were three manufacturers who employed journeymen. In that year one John Adam Dagyr, a Welshman by birth, began manufacturing, and won a reputation for his shoes throughout the colony.

During the Revolution most of the shoes worn by the Continental army, as well as nearly all ready-made shoes sold throughout the colonies, were produced in Massachusetts, and we find it recorded that "for quality and service they were quite as good as those imported from England." Immediately after the Revolution, in consequence of large

importations, the business languished somewhat. It soon recovered, however, and was pursued with such vigor that in 1795 there were in Lynn 200 master workmen and 600 journeymen, who produced in the aggregate 300,000 pairs of ladies' shoes. One manufacturer in seven months of the year 1795 made 20,000 pairs. In 1778 men's shoes were made in Reading, Braintree, and other towns in the Old Colony, for the wholesale trade; they were sold to dealers in Boston, Philadelphia, Savannah, and Charleston, a considerable portion being exported to Cuba and other West India islands.

About the year 1795 the business was established in Milford and other Worcester County towns, where brogans were made, and sold to the planters in the Southern States for negro wear. The custom at this time was for the manufacturer to make weekly trips to Boston with his horse and wagon, taking his goods in baskets and barrels, and selling them to the wholesale houses. He was often met at Charlestown Bridge or Boston Neck by the more enterprising dealers, who were thus able to get the first selection of whatever the manufacturer had to sell. Until 1815, with the exception of a few shoes which had been made copper-nailed for export to Cuba, all footwear was hand-sewed; the coarse and heavy boot was welted, while light shoes and slippers were turned. But in the year 1811 wooden shoe-pegs were invented. They came into general use in 1815, and may be said to have brought about the first revolution in the method of shoe manufacture.

Before that time, for centuries, the industry had remained at a standstill so far as improved methods were concerned. The shoemaker sat on his bench or "seat," cut with a knife the upper and sole leather from the side, stitched the upper, while held in a clamp, with awl and waxed end, hammered the sole on a lap-stone, and sewed it on by hand, turning out a complete shoe from beginning to end with hardly any other tools than a hammer, awl, and knife, and a wooden shoulder-stick, with which he finished the edges. Every operation was done precisely as his fathers had done it before him. Indeed, the shoemaker himself often fashioned the lasts from the wooden block to fit the feet of his customer.

Now began what has developed into that marvel of mechanical ingenuity and perfection of method —the modern shoe factory. In Randolph, Abington, Holbrook, and Quincy, in the Old Colony; in Lynn, Salem, Topsfield, Georgetown, and Haverhill, in Essex County; in Stoneham, Reading, and Marlboro, in Middlesex County; and in Milford, Brookfield, and Spencer, in Worcester County, shoemakers hired a few of their fellows and gathered them into what was then called a shop, one cutting the leather, others fitting or sewing the uppers together, and still others putting the uppers and soles together, or bottoming them, much the same as had been done when each shoemaker worked individually. The partial division of labor was a success at once, and soon the uppers were sent out to women and children to be stitched together and bound. "Hannah binding shoes" might have been found in almost every home in the shoe towns in eastern Massachusetts. Little eight-by-ten-foot shops were scattered all through the South Shore, in Essex and Middlesex counties, and in some portions of Worcester County, where the shoemaker with his sons, and perhaps a neighbor, made a "team" which took the fitted uppers and the understock from the manufacturer in a near-by town and bottomed the shoes or boots. One did the lasting, another the pegging (the boys, and sometimes the girls, were taught this branch), another the trimming, and still another the edge-setting; but all was done by hand. When the shoes were made they were taken to the factory, which, although considered at that time a wonder, was but little larger than the offices of some of our modern establishments. Here they were finished, packed in wooden boxes, and sent to the market. In this way the industry prospered, being carried on without any further marked improvement in methods until about 1850, when machinery was introduced.

The first machine to be of practical use was the rolling-machine, by which a man could do in a minute what would require half an hour's hard work with a lap-stone and hammer. Next came the splitting-machine, in 1855; then, in 1857, the racing-machine, to cut the leather from the side into strips. These were all worked by a crank and turned either by hand or foot, and were used to prepare the sole-leather for the shoemaker. The sewing-machine had been invented by Elias Howe in 1845, and came into practical use in 1854. A patent for a hand pegging-machine had been taken out in 1833 by Samuel Preston, of Danvers; but it seemed not to have been a commercial success, for most of the shoes were pegged with hammer and awl until 1851, when A. C. Gallahue, Elmer Townsend, and B. F. Sturtevant patented a pegging-machine which cut and drove a peg from a prepared strip. Although this machine was invented in 1851, it was not perfected so as to become of practical use until 1858 or 1859, when power had been applied to drive machinery.

In 1855, William F. Trowbridge, of Feltonville, Mass. (then a part of Marlboro, now the town of Hudson), a partner in the firm of F. Brigham & Company, conceived the idea of driving by horse-power the machines then in use. In a building attached to the factory he established a sweep, around which a horse known for a score of years in that section as the "Old General" provided the first power other than manual which ever drove shoe machinery. For some years prior to that time two or three stout Irishmen had supplied the motive power in this factory. Soon afterward steam power was used in the factory of John Hill & Company, Stoneham; and one after another of the larger manufacturers throughout the Eastern States found it necessary to adopt modern methods, so that after the year 1860 there were very few of any pretension who did not use either steam or water power to drive their machinery. This opened up the way for numerous improvements. None was of more importance than the Howe sewing-machine, which was now brought into general use. Waxed-thread sewing-machines were also introduced in 1857, by which the uppers of nearly all heavy shoes are stitched together. Buffing-machines had been run by foot as far back as 1855, but were now all driven at high speed by power. Power-machines for dieing out soles and heels were introduced in 1858.

Probably no other machine has caused so great a revolution in the business as the McKay sewing-machine, which came into use in 1860. With it a man can sew the soles of 500 or 600 pairs of shoes in a day. In 1874 there were 1200 of these machines in use in the United States; in 1878 there were 1600, sewing 60,000,000 pairs annually; in 1881 there were 2000 machines, sewing 82,000,000 pairs; and in the present year (1895) there are 4000 machines working more or less, business being rather dull, and the production is estimated at 120,000,000 pairs. The Bigelow heeling-machine, which presses into a solid mass the leather heel and sets the nails ready for driving, and also a machine, called the Bigelow attacher, which drives the nails and attaches the heels, were introduced in 1870. The McKay heeling-machine, which does the same work and also trims the heel, came into use in the same year. In 1871 heels were put on to over 10,000,000 pairs of shoes by the McKay and Bigelow machines; in 1876 over 27,000,000 pairs; in 1881 over 45,000,000 pairs; in 1886, 59,000,000 pairs; and in 1890 over 72,000,000 pairs.

Heel-burnishing machines had been used since 1865. Another important invention shaping the advance in shoe manufacturing was the cable screw wire-machine, invented in 1869, which fastened the sole and upper together with wire, very much as had been done before with pegs. This machine was superseded in 1875 by what is now known as the standard screw wire-machine, which connects the sole with the upper by turning in a screw and automatically cutting off just the right length, making one of the strongest fastenings possible. The edge-trimming machines, chief of which is the Buzzell, were generally introduced in 1876. Various attempts have been made since 1860 to introduce machines for lasting, and there have been in use for some years several which successfully perform the work; they are fast superseding hand-work.

Another great change in the industry has come with the Goodyear welt-machines, which were introduced in 1877, and are now in general use throughout the United States and many foreign countries. By the Goodyear process a shoe is produced very much the same as by the hand-sewed workman, one machine sewing on the welt and another afterward stitching the sole to the welt. In 1880 250 of these machines were running, on which were sewed 2,000,000 pairs of shoes; in 1885 500 machines sewed 4,000,000 pairs; in 1890 1500 machines sewed 12,000,000 pairs; in 1895 2500 machines will sew 25,000,000 pairs. The Campbell lock-stitch machine for stitching the out-sole to the welt was perfected and brought out in 1884, and is used extensively. The Campbell welt-sewing machine was successfully introduced in 1890. The Eppler welter and stitcher have been in successful operation for several years.

All of these machines have shortened and simplified the processes until it is quite within the truth to say that the product of the labor of one man in the modern factory is equal to a dozen on the bench in 1830. While the improvement in method has greatly cheapened the cost of shoes to the wearer, the skilled shoemaker has earned steadily increasing wages. Early in the century, after having served his seven years' apprenticeship, the journeyman shoemaker, if he were active and industrious, could earn $4 to $6 a week. In 1895 the skilled workman is not satisfied with less than three or four times as much.

Although on going through a modern shoe factory one would think perfection had been reached, no season passes without the introduction of some new machine which works a revolution in its particular sphere.

Until well along in the present century there was

little attempt to establish the shoe industry outside eastern Massachusetts. Yet it was not to be expected that other enterprising sections would be content always to depend entirely on New England for so important an article of merchandise as shoes. In New York City and other cities of New York State, especially in Rochester, the industry has attained large proportions, and has reached a perfection not excelled anywhere. In Newark, N. J., where the business was early established, are made many of the finest shoes for men's wear. Philadelphia has made the shoe industry a leader among the many manufacturing industries for which she is celebrated. At Cincinnati and St. Louis ladies' shoes are produced in great quantities, and of a style and finish that have won a reputation. Chicago has taken up the business with an energy that has already placed her in the front rank. Many of the pioneer shoe jobbers of her early days came from Massachusetts, where they had learned the business; and in the year 1895 she boasts of several factories which equal any others in the country. There is hardly a town of any pretensions that has not its shoe factory, either built or projected. Too many of them, however, are already monuments which tell the old story that a fine building, even when backed by capital contributed by the citizens of a town, is not a guaranty of financial success. In these days of sharp competition a knowledge of the business and a corps of trained shoemakers are requisites which cannot be dispensed with. Still throughout the West, including the Pacific coast, there are many thoroughly equipped, financially successful shoe factories.

Notwithstanding the enterprise of other parts of the country, New England still maintains the lead as the home of this industry. She has steadily advanced, the average increase being about $4,000,000 a year, until in the year 1894 there was produced within her borders an aggregate output valued at about $150,000,000. Boston is the center from which are sold nearly all the goods made in New England, amounting to about two thirds of the entire production of the country. The following table, giving the number of cases shipped annually from Boston for the years mentioned, will show the steady increase in the business. This represents but a part of the New England production, many goods being shipped to the West and South directly from the factories.

Year.	Cases.
1859	684,708
1865	718,660
1870	1,250,201
1875	1,449,180
1880	2,263,890
1885	2,717,795
1890	3,533,239
1892	3,709,564

When it is further considered that the flourishing New England cities and towns of Lynn, Brockton, Haverhill, Marlboro, Milford, Whitman, the Weymouths, and many others, are built up and maintained solely by the boot and shoe and allied interests, the force which this industry has exerted on the community at large becomes apparent. Among the cities of the country where the manufacture of boots and shoes in 1890 constituted all or a portion of the manufacturing industry were the following:

Cities.	Factories.	Capital.	Wages.	Material.	Product.
Lynn	323	$10,569,470	$6,832,938	$14,757,089	$25,850,005
Philadelphia	93	4,185,794	2,391,509	3,151,927	6,851,834
Rochester	51	3,734,025	1,913,625	3,456,385	6,489,382
Brockton	73	6,180,188	4,916,936	8,844,474	16,171,624
Haverhill	201	5,926,222	4,445,164	7,339,815	14,963,642
San Francisco	55	2,425,617	1,228,063	1,483,256	3,315,043
Brooklyn	65	1,327,119	1,032,547	1,432,934	2,813,209
St. Louis	24	4,170,027	1,155,635	2,107,854	4,250,961
Detroit	7	975,907	476,424	913,916	1,611,700
Cincinnati	28	2,029,194	1,554,416	2,622,293	5,032,980
Newark	17	1,190,083	899,797	894,897	2,216,129
Worcester	22	2,042,743	927,084	2,125,358	3,503,877
Milwaukee	17	1,909,255	483,472	818,070	1,617,534
New York	76	2,033,273	1,994,163	2,473,015	5,306,411
Chicago	44	3,133,289	1,749,095	3,977,429	7,257,034
Marlboro, Mass	18	1,437,861	1,463,897	3,889,988	5,831,028

To show the magnitude and importance of this industry to the whole country, and its steady growth, the following comparison from the census of 1880 and 1890 will be interesting:

BOOTS AND SHOES—FACTORY PRODUCT.

	1890.	1880.
Establishments reporting	2,082	1,959
Hands employed	139,333	111,152
Value of material	$118,735,831	$102,442,442
Value of product	$220,649,358	$166,050,354

BOOTS AND SHOES—CUSTOM WORK.

	1890.	1880.
Establishments reporting	20,803	16,013
Hands employed	35,448	22,667
Value of material	$10,403,383	$12,524,133
Value of product	$34,856,651	$30,870,127

Besides the above, in 1890 there were $3,346,-000 worth of boot and shoe uppers manufactured and sold. In this same year there were sold about $3,500,000 worth of boot and shoe findings, about $3,000,000 shoe-blacking, and nearly $18,000,000 boot and shoe cut stock. There were manufactured and sold about $1,239,065 worth of lasts.

For an intelligent understanding of the position this industry has secured in the various sections of the United States, the following table, made up for the year 1890, will be interesting:

States and Territories.	Establishments Reporting.	Value of Products.
California	56	$3,395,043
Connecticut	20	1,535,125
Georgia	3	18,542
Illinois	56	8,756,824
Indiana	6	179,936
Iowa	6	574,378
Kentucky	11	526,387
Louisiana	17	968,017
Maine	53	10,335,342
Maryland	28	1,533,761
Massachusetts	1,057	116,387,900
Michigan	12	2,065,531
Minnesota	8	2,032,814
Missouri	29	4,841,004
New Hampshire	64	11,986,003
New Jersey	109	7,255,409
New York	257	23,661,204
North Carolina	4	155,900
Ohio	63	8,489,728
Pennsylvania	158	10,354,850
Rhode Island	3	158,800
Texas	3	109,850
Vermont	7	529,486
Virginia	7	1,279,069
Wisconsin	32	2,972,233
All other States and Territories	13	546,222
Totals	2,082	$220,649,358

No account of the manufacture of boots and shoes could be complete without reference to the employment of convict labor. The business offers many advantages to the authorities of prisons who are seeking work for the men and women in their charge which will bring some remuneration to the State. The great number of operations in producing a shoe make it possible to use all classes of convicts, from the strong to the weak; and as far back as 1850, even before machinery was introduced, it was not an uncommon thing for houses of correction and prisons to produce footwear not only for their own convicts, but to be sold in the market. After the introduction of machinery, and during the demand for cheap shoes which followed the close of the Civil War, many of the States leased the labor of their convicts to shoe manufacturers. In the year 1870 there were employed in this industry in twenty-six different States 6581 convicts, while there were only 129,989 employed in the industry in the same States outside the prisons. In the fiscal year 1886 there were made by 7609 convicts 6,634,960 pairs, valued at $10,990,173. It is difficult to get reliable figures since 1886, but it is probable that the number employed and the annual production are steadily increasing. In States where the system was believed to have a harmful influence on the wages of the workmen outside the prisons the business has been conducted on the States' account, and in some instances, at least, the result has been disastrous. Attempts have been made, in the supposed interest of labor, to forbid prison authorities to use the convicts in any industry which would compete with outside labor. At the present time, and in view of the fact that the boot and shoe factories of the United States can produce in nine months all of the shoes required for consumption in twelve months, and that convicts must be worked nearly every week-day of the year, their employment at shoe-making must have more or less effect on the market.

What were called "gum shoes" had been imported from South America for some time prior to the discovery of the vulcanization of rubber by Goodyear in 1844, although this event laid the foundation of the present prosperous business of manufacturing rubber boots and shoes. In its discovery and early manufacture this industry is purely American, and as early as 1847 we were sending to foreign countries, in limited quantities, the product of our American rubber factories. The business was first established in Rhode Island and Connecticut; later several large concerns were located in New Jersey. Its growth has been steady and sure until the present time. The following table, taken from the census, will show that the business nearly doubled in magnitude from 1880 to 1890:

	1890.	1880.
Establishments reporting	11	9
Hands employed	9,264	4,662
Value of material	$11,650,787	$6,023,053
Value of product	$18,632,060	$9,705,724
Wages paid	$3,966,875	$1,469,038

The amount exported is shown by the following figures: 1885, $89,216; 1890, $149,000; 1892, $183,000; 1893, $252,000. In 1894, probably on account of a sharp rise in prices, it fell to $153,000;

but there is now evidence that the export trade in these articles for 1895 will show a large increase.

In the colonial days there was but one profit, to be paid by the consumer; the shoemaker and retail dealer coming directly together. The merchants sold shoes over the same counter with rum, molasses, dry-goods, hardware, and provisions. It seems certain that one Isaac Ellerton, of Plymouth Plantation, was the first American shoe dealer. In 1628 he was commissioned by Governor Bradford and a syndicate of colonists to proceed to England and purchase a stock of shoes, hosiery, and linen cloth. The syndicate subscribed $250, with which capital the venture was made and proved successful. It was only in the more remote districts and among the poorer settlers, who were contented with a coarse grade of goods, that ready-made shoes found much favor. Barefooted men and women about the clearings and farms were not rare, but the wealthy classes, merchants, and landed gentry all employed the custom shoemakers. For these reasons the boot and shoe trade was but an ordinary item in the ledgers of the general store until well along into the second and third decades of the present century. Nearly all the wholesale dealers of that day were jobbers as well, and the South and West were the great markets. St. Louis was the distributing center for the Southwest, and Savannah for Georgia and the Southern coast region. The New England wholesale dealers sold boots and shoes to the grocers, dry-goods and hardware men throughout the country as well as to the shoe dealers proper. Cases of Massachusetts shoes were kept in country stores all through the South and West, for which the small trader paid only as he sold.

Among the men who were identified with the boot and shoe trade and leather manufacturing about the time the present century opened were Perez Bryant & Company (1810), Isaiah Faxon (1812), Silas Tarkel, Asa Hammond, Amos Stetson, Samuel Train, E. Thayer & Company, Lee Claflin, and T. & E. Batcheller, of Boston; Sheppard Knapp and Gideon Lee & Company, of New York; Nathan Tufts, of Charlestown; the Southwicks, of Vassalboro, Me.; Hunt & Loud and H. H. Reed, of Weymouth; Arza Keith, of Abington; and Isaac Prouty, of Spencer.

In 1828 the total sales from Boston by jobbing-houses were over $1,000,000, and there were four jobbing-houses in New York, who together sold $600,000. From 1828 on, with the exception of 1837 and 1838, the trade in Boston increased very rapidly, until in 1856 there were 200 wholesale and jobbing houses, with domestic and foreign trade annually of over $50,000,000. In New York City there were fifty-six houses, that sold annually $15,000,000. From 1830 on, jobbing-houses were established in all the larger cities of the West and South, which handled boots and shoes and hats and caps. They bought their boots and shoes of Eastern manufacturers on six, eight, and ten months' time, and sold them to their customers to be paid for when the crops came in. The manufacturer seldom received any ready cash. He took notes and depended upon discounting them in bank for money to carry on his business, although at that time he bought his leather on time and made contracts with his help for six months. Settlements were made only at the close of the contract. The employer issued a species of currency called "orders," which could be used at certain specified country stores, so that the workman could obtain necessary supplies; but very little money was ever seen excepting on the semi-annual settlement day. To be sure, by allowing a large "shave," the workman was sometimes able to get his "orders" cashed. It was not uncommon for a well-to-do employer to add to his gains by shaving his own orders.

It can be readily seen that this system of extended credits was dangerous, and the usual result followed in the panics of 1837 and 1857, when many of the large jobbing-houses and manufacturers suspended payments, the Eastern manufacturer having his own notes to take care of and also the notes of his customers which he had indorsed for discount in the bank. It was not an unusual thing for men who were, without question, perfectly solvent to suspend and get an extension on their notes. It was a common thing for the Southern and Western jobbers to expect an extension without any suspension of business. When the Civil War broke out in 1861 large sums were owing to Northern manufacturers by the jobbers in the Southern States. To their great honor, some who were able paid their indebtedness in full at the close of the war; others paid what they could; but more were so impoverished that they could pay nothing. The losses were so great in 1861 that many manufacturers who had supposed themselves wealthy became insolvent. But values, measured by the currency of the country, rose so rapidly after the breaking out of the war that men of enterprise quickly recovered their financial position. It was only necessary to buy merchandise; the profit was secured by the steady advance until toward the close of the war. During this time paper money had grown so plentiful that

there appeared in the market an occasional dealer who was ready to pay cash; the usual terms of sale were six months' time or five per cent. off for cash in thirty days. Still the old-time jobber, although he might believe himself wealthy, remained steadfast to his plan of giving his six months' note, selling his merchandise on time, and often extending to his country customer an additional six months, charging and receiving his twenty-five to fifty per cent. profit; while at the end of each year he had less money than the year previous, he could figure on paper that he had made a handsome gain.

But the dealer who paid cash for his goods, getting all the discounts and all the advantages that cash may bring, could sell to retailers who paid him cash at a very much less profit than the old-time jobber thought it was possible to do business upon. Very naturally this new class of jobbers gathered round them the best and more enterprising of the trade, leaving the chaff for their less active competitors. The panic of the year 1873 brought this condition of affairs to a climax. Many of the long-credit houses were forced to suspend payment, and few paid anything more than a fraction of their indebtedness. Since that time on the business has been on a much better basis, so far as losses by bad debts are concerned; but the intense competition, by both manufacturers and dealers, has reduced the profits to a point where a large business must be done in order to make any considerable volume of annual gain. While in 1860 a jobbing-house that did a business of more than $300,000 was an exception, there are in 1895 several throughout the country that claim to do between $4,000,000 and $5,000,000 annually, and the house that does less than $1,000,000 is considered of third or fourth rank.

In 1860 one or two styles of lasts were considered sufficient for a manufacturer to use on any particular line of goods; now no stock is complete that does not have many different styles and many widths of each style, so that there can be found something that will fit nearly every foot.

The quality of the goods, also, has been so materially improved that the tastes of the average consumer can be met at the counter of any good retail store. For this reason the custom of making shoes to measure is passing away. The factory-made goods are in such complete variety that the most fastidious can find something to their taste without the delay of waiting for special workmanship. This great variety compels the wholesale dealer who will be up to date to carry a large stock, and in the busy season it is not uncommon to find $1,000,000 worth of boots and shoes under one roof, while the average stock of all large dealers runs up into hundreds of thousands.

The old-time method was supposed to give first a profit to the manufacturer, then to the jobber, and then to the retailer; and the losses accruing from extended credits made it necessary to charge profits so large that by the time the shoe reached the consumer the price asked for it would be twice the factory cost of production. By the later and improved cash methods the greater portion of factory production reaches the counter of the retailer at a cost often not in excess of ten per cent. over the net cost at the factory. These close profits have compelled manufacturers to adopt the most direct methods of reaching the consumer. Some have made alliances with jobbers who take most of their production and sell it at a nominal profit. Others have opened on their own account retail stores in the larger cities of the country, and claim there is but one profit from the manufacturer to the consumer. In all these methods we are but following out the history of the trade in Great Britain, in Germany, and in France, where now the most of the better retail stores are owned by large manufacturers who supply their goods directly from the factory. It would seem as though this shortening of the road between the manufacturer and the consumer were now complete. Able, enterprising men, with ample capital and every facility for producing footwear, find it possible to make only the most meager margin of profit. Happily for the consumer, there is and can be no combination to control the price of shoes. If it were possible to buy up all the factories and put them under one control, hundreds more would spring up, like mushrooms, in a season. The sharp competition has forced the manufacturer to practise every economy and to study every possible improvement in machinery, until to-day the United States is far in advance of every other nation in the perfection, quality, and low cost of its footwear. While our workmen earn more, they produce more. The conditions under which they work are more favorable to large production. To be sure, the industry is not without its labor troubles. Shoemakers, like other men, have learned that by combination they can secure advantages, and they have occasionally attempted to exercise that power in a way to threaten the prosperity of the industry. The much-talked-about conflict between labor and capital sometimes temporarily appears, but the intelligence,

William B. Rice.

good sense, and pecuniary interest of both so far always have, and no doubt always will assert themselves so strongly as to bring peace, without which there can be no business success.

As has already been said, there is no question but that the United States leads all other countries in the production of footwear in quantity, cost, quality, style, and perfection of manufacture. Our superiority was generally admitted after the World's Fair at Chicago. Here expert shoemakers and shoe dealers came from all parts of the world, and, after complete examination of our methods and our production, returned to their own countries and made clear the fact that in this industry, at least, the United States need not fear foreign competition. But our facilities for production are very much in excess of the home demand for consumption. We need a larger market for our goods.

Our early manufacturers were able to export to the West Indies, and more especially to Cuba, and up to the time of our Civil War the export business was prosecuted with vigor and profit. In 1810 ten per cent. of all the boots and shoes sold in Boston were for export. In the year 1865 we exported more than $2,000,000 worth. From that time on the trade fell off sharply. Perhaps this may be accounted for by the great advance in 1866, when values rose at least fifty per cent. This is illustrated by the fact that where 1,214,468 pairs sold for export in 1863 for $1,329,000 (about $1.10 per pair), 214,567 pairs exported in 1866 brought $590,000 (over $2.75 per pair).

Probably on account of the demand for home consumption little effort was made during the next twenty years to secure any foreign business. The trade seldom rose above $500,000 a year. An examination of the figures will show, however, that after 1872 this was not caused by excessive cost of materials, because our export trade in leather increased sharply from that time on, until in 1894 we exported about $14,000,000 worth.

Within the last few years renewed interest has arisen in the export business. Our manufacturers have become convinced that there is nothing in the conditions which will prevent competition with England, France, or Germany for any part of the trade of the world. We have the raw materials in our own country. While we import many hides and skins, the supply of our domestic product is constantly increasing, and our leather manufacturers have been able to produce, in both quality and price, materials for making shoes as advantageously as any other country. We now need to adapt our styles to the wants of such countries as import their footwear. Large dealers from England, from Australia, from South America, Central America, and South Africa, have visited our market within the past two years, ready to buy our goods if we will meet their views as to shapes. Some of our leading manufacturers are alive to the situation and are making an effort to secure a portion of the world's trade.

It must be admitted that a more determined, energetic spirit on the part of the boot and shoe manufacturers of the United States is necessary if they are to extend their trade to profitable markets they are now neglecting. The export trade of Great Britain in boots and shoes is far greater than our own, but the larger portion of her exports go to Australia, South Africa, and other of her colonies. France, Germany, and Switzerland each exceeds us in amount of exports.

Annexed will be found a table giving our exports of boots and shoes and of leather and manufactures of leather since 1857.

EXPORTS, 1857 TO 1895.

YEAR ENDING JUNE 30TH.	BOOTS AND SHOES.		LEATHER AND ALL MANUFACTURES OF LEATHER.
	Pairs.		
1857	561,501	$813,995	$1,359,050
1858	609,982	663,905	1,337,873
1859	627,850	820,175	1,420,228
1860	678,136	782,525	1,547,177
1861	655,808	779,876	1,404,054
1862	679,594	721,241	1,191,056
1863	1,214,468	1,329,009	2,140,013
1864	....	1,415,775	1,931,126
1865	....	2,098,165	3,193,648
1866	214,567	590,307	1,033,829
1867	313,290	681,706	1,049,615
1868	363,419	578,650	1,414,372
1869	303,884	475,607	925,283
1870	276,179	419,612	673,331
1871	301,216	445,466	1,897,395
1872	325,296	502,689	3,684,029
1873	260,759	421,548	5,305,494
1874	243,500	383,417	4,786,518
1875	393,051	429,363	7,324,796
1876	263,508	368,633	10,008,985
1877	300,484	414,630	8,167,301
1878	351,152	468,436	8,080,030
1879	329,355	402,557	7,769,069
1880	378,274	441,069	6,760,186
1881	300,968	374,343	8,088,445
1882	389,120	488,815	8,999,927
1883	442,687	539,957	7,923,662
1884	502,122	602,925	8,305,779
1885	492,906	598,151	9,692,408
1886	554,365	648,069	8,737,682
1887	623,714	732,517	10,436,138
1888	563,871	654,896	9,583,411
1889	518,750	585,902	10,747,710
1890	587,106	662,974	12,438,847
1891	551,343	651,343	13,278,847
1892	745,112	914,974	12,084,781
1893	493,027	590,754	11,912,154
1894	647,318	777,354	14,282,936
1895 (9 months)	700,836	880,652	12,279,480

For the first nine months of 1895 our export trade in shoes amounted to $880,652. Shipments of leather and its manufacture for this same period amounted to $13,885,842.

A comparison of the export trade in boots and shoes of Great Britain and the United States, from 1865, is shown by the following table:

Year.	England Exported.	United States Exported.
1865	$7,310,525	$2,098,165
1871	8,520,725	445,466
1876	7,017,330	368,633
1890	8,460,000	662,974
1892	8,499,870	914,974
1894	....	777,354

For convenience in figuring, the English pound sterling is figured at $5.

The total export trade of Europe in footwear is estimated at $35,000,000. There is nothing to prevent our securing a respectable part of this except our indifference.

In this industry American genius has contributed more than any other factor toward the universal development. Americans are better shod than the inhabitants of any other country. Titled Europeans may wear as fine shoes, but the great, strong middle class, which supports not only itself and the aristocratic pretension, but the very nation, has neither the comfort, elegance, nor convenience in footgear that American invention and enterprise have placed within the reach of every citizen of our land. Supporting more people now than ever before, paying more wages, and rearing up great tributary occupations, the boot and shoe trade has lifted itself into the front rank of American manufacturing interests.

W B Rice

CHAPTER LXXXVIII

THE HARNESS AND SADDLERY TRADE

THE harness and saddlery industry of the United States in the early part of the present century seems to be shrouded in obscurity. In its incipiency this industry showed much crudeness and large room for improvement. Agricultural development was extremely slow. The soil was turned by a wooden plow to which oxen were attached, bearing a heavy wooden yoke tied with coarse rawhide thongs. The process of harvesting was equally crude. The roads were in an almost impassable condition, very little improvement having been made in this direction, except in the towns and cities of the New England States. The condition of the roads to the interior settlements was such that freight could be conveyed only on pack-horses, and later by two-wheeled carts drawn by oxen. Under these conditions it may be easily understood that there would be a very small demand for harness, least of all of the lighter grades, because light vehicles would be entirely unsuited to such roadways.

The horse was chiefly used for saddle riding. The United States mails, the news, and important messages were sent by mounted messengers, the majority of the equipments for this use being imported from England. The saddle-trees, buckles, bits, etc., required for the few riding-saddles made in the United States were necessarily imported, for the reason that those made in this country were of a very primitive form. Saddlery hardware, one of the important accessories to the saddlery business, was first made by Seth J. & Alvin North, at New Britain, Conn. They conducted a blacksmith shop, where, among a large variety of articles that they made, were bridle-bits, harness and shoe buckles and rings. These were produced from wire drawn out at first by hand, but later by horse-power. All the finishing work on these goods, such as polishing, welding, and putting on the tongues of the buckles, was executed manually, naturally a slow process, and but few goods could be turned out in any given month or year.

Learning that a more rapid process than hand-polishing was in use at Middletown, Conn., Alvin North, one of the partners of the above-named firm, went there to learn the process. After paying $25 for the secret he was told to take an old woolen stocking and, after darning the holes, fill it with the articles to be polished, and add a number of small pieces of soap. The whole was to be dipped into a pail of warm water, the stocking then being rubbed between the hands. This process was certainly a quaint and simple one, but the firm found that it would save the labor of half a dozen girls. Subsequently they substituted canvas bags for the stockings, which were used until the introduction of tumbling-barrels.

As civilization advanced, there came a demand for better roads and driveways, and with this arose a greater need of saddlery. Factories were established, the chief of these being in Newark, N. J., Hartford, Conn., Wheeling, W. Va., St. Louis, Mo., Louisville, Ky., and Cincinnati, O. The greater part of the harness made at this time was for heavy stages and wagons, used for transportation of passengers and in business traffic for agricultural purposes. The deep black soil of the Western prairies made carrying goods by wagons during certain seasons of the year impossible, and as a result the call for riding-saddles became urgent. Saddles made in foreign countries were not suited to the undeveloped West, with its rude frontier life, nor were they adapted to the South, where conditions were equally peculiar. Thereupon the inventive genius of the Yankee produced a tree made of wood, covered with rawhide. With its long skirts and fenders it was a protection from the elements and the numerous and deep quagmires.

The inconveniences under which manufacturers labored, especially in the West, were those of obtaining their supplies of saddlery hardware for making these horse equipments. It was necessary to import

largely from England, and it required many months after the order was placed before the goods were received. This was because they were shipped by sailing vessels to New Orleans, and then sent up the Mississippi and Ohio rivers to their respective destinations. During the years from 1822 to 1833 the importation of foreign saddlery hardware was large, such things as bits, buckles, spurs, stirrups, rings, and also webs of all kinds being imported. In 1828 the Franklin Institute awarded a medal to Seth Boyden for the first buckles and bits made of annealed cast-iron. It is said that the process was first attempted by putting a few pounds of cast-iron into an ordinary cooking-stove. In this manner it was discovered that the cast-iron by being baked became annealed, and thus a great stride was made toward the successful manufacture of saddlery hardware in this country.

It might be proper at this point to note a little of the personal history of one of the most remarkable men in the saddlery trade—one to whom more is due for the progress and prominence of the saddlery interest than to any other man. This was Peter Hayden. He was born in Oneida County, New York, in September, 1806, and was brought up in Cummington, Mass. He was a member of a family of inventors, and gave evidence in early life of his predilections for mechanical pursuits. About 1828, when Hayden was twenty-two years of age, he commenced the manufacture of hames and saddlery at Auburn, N. Y. Few men were employed at the start. When the stock accumulated he would load up a wagon or sleigh and sell his stock in central New York and Canada. In 1835 Mr. Hayden entered into a contract with the State of Ohio for the employment of convict labor in the manufacture of hames, saddle-trees, saddlery hardware, and chains, employing at different times from 100 to 300 convicts, besides a large force of free labor. He was eminently qualified for the business of manufacturing, as his mechanical skill and ingenuity enabled him readily to determine the best means for accomplishing results. He had industry and perseverance, and united with these a ready willingness to take hold of any branch of his business and by personal effort bring it to a successful issue. As his business increased he extended it into other departments, ultimately opening connection with mercantile houses for the sale of his manufactures in Cincinnati, St. Louis, Chicago, Detroit, Galveston, San Francisco, and New York City. Thus from a very small beginning, aggregating at the start a few thousand dollars per year, his business increased until it reached millions, and the importation of foreign saddlery ceased almost entirely through his efforts.

The business of making horse-collars was first undertaken in this country by Timothy Deming in 1828, at East Hartford. He invented the short-straw collars and the blocks on which to make them, patenting the latter. Previous to this time collar makers lived the life of itinerants. Their practice was to go from place to place and hire themselves to any of the harness makers whose stock of collars needed replenishing.

There was but little change during these years in the mode of manufacturing saddlery. The custom in vogue for twenty-five years still prevailed. Such harnesses as were turned out were intended for hauling and for agricultural uses. Machinery was not in use in the earlier years of this period, and few, if any, wholesale establishments existed during this quarter-century. It needed the introduction of machines to bring about the concentration of capital and the massing of workers into large factories. This may be attributed to the fact that without machines the large establishments would have no particular advantage over the smaller ones, and therefore there would be no incentive to manufacture on a large scale. The principal manufacturers were jobbers as well, and carried a stock of saddlery hardware. They were located in the larger cities, supplying small makers throughout the surrounding territory. In those years the buyers visited the makers—quite a reversal of present-day practices. The modern traveling salesman carries the market to the buyer.

In 1853 the first wax-thread chain-stitch sewing-machine was patented by a New England company. Three years later it was brought into practical use, but was employed almost exclusively upon the sewing of boots and shoes in the New England States. It was nearly ten years later before it was used in the manufacture of harness. The prejudice was very great against machine-stitching. Many years, therefore, passed before it was used to any extent. The rapidity with which the work could be done by this machine, and the great reduction it effected in the cost, gradually brought it into favor with the maker. Another very important improvement was the creasing-machine. This was originally invented by W. K. Thornton, of Niles, Mich., about 1858, and proved to be a great labor-saving device. The small trade, however, was quite slow to adopt anything which made a radical departure from old-time and traditional methods, and the inventor was obliged

Albert Morsbach.

to introduce his machines from shop to shop by leaving them on three months' trial. A few years later he entered into partnership in Cincinnati under the firm name of Thornton & Perkins, the business being in 1865 sold out to Randall & Company, now the manufacturers of the modern and improved machines.

The New England sewing-machine and the creasing-machine were the only two important inventions of which we have any record that proved to be of lasting benefit to the trade, and to them may be credited the beginning which led to the revolution in the manufacture of harness. Probably the most important invention up to this time relating to harness was the iron gigtree. E. A. Cooper, of Lancaster, N. Y., patented a tree April 3, 1866. The most practical gigtree, and one almost universally used by the saddlery trade, was subsequently patented by Samuel E. Thompkins, of Newark, N. J., on January 30, 1872. The importance of this invention may be better understood when it is stated that all the buggy saddles purchased up to this time were made on wooden trees, most of these being imported from England, and it was only a few years after the iron tree was introduced that the wooden tree was discarded.

The government census of the industry made at the close of this period will serve to show its extent. Considering the primitive ways of producing the goods, it is no wonder that the value of the product was small as compared with the report of twenty years later, which, it should be remembered, included only one third as many establishments. The number of establishments was 7607; the total capital employed, $13,935,961; the wages paid, $7,046,207, and the number of employees, 35,555; the total product, $32,709,981.

The progress in the saddlery business at this time was phenomenal. Improvements and labor-saving machinery were introduced into the large factories. As a result the cost of products was naturally lessened, and as a logical sequence the demand for the goods was increased. Light driving or buggy harness, which previous to this time was sold in small quantities only, now found a large market. Factories were taxed to their utmost capacity to supply the needs. The low-priced carriages and buggies which now appeared in the market contributed in no small degree toward swelling the call for harness. Hitherto such vehicles were turned out by hand process only; but now machinery entered into their production, with the inevitable result of cutting down the cost and increasing the demand. A greater use of vehicles of this sort meant, of course, a great stimulus to the manufacture of light harness, which was revolutionized. The apprentice system of turning out skilled mechanics seems to have been abolished, it being no longer the rule to serve long years at the bench. The work was now accomplished by a division of labor. No single workman made a complete harness. He exercised his skill upon the production of single parts, and hence became proficient in turning out that subdivision for which he had special aptitude.

Many labor-saving devices and machines were now used. Space will not permit mention of many of these, but as illustrative of the changes and conditions which were now operative reference might be made to one or two of the principal machines. The Bosworth lock-stitching wax-thread sewing-machine was patented in March, 1872, and reissued in 1880 and 1882; and later the Campbell lock-stitching machine, which was patented in 1880 and reissued about 1888, to a great extent supplanted hand-sewing. The stitches were interlocked, making the sewing alike on both sides, and giving the appearance of hand-sewing. This was a great boon to this industry, for the harness-sewing machines previously used were objectionable to a great degree, as they made a chain-stitch, and the work was not as satisfactory. These new machines were leased upon a payment of a bonus and an additional rent of five cents for each 1000 stitches. Subsequently competition brought about a reduction in the cost of operating the machines, the charge taking the form of a regular monthly rental.

The following kinds of harness machinery have been great labor-saving inventions, and are considered indispensable in well-equipped factories: tubular riveting-machines, dispensing with the hand-riveting entirely; box-loop sewing-machines, sewing up all the long loops, formerly sewed by hand; quilting-machines for quilting pads, gig and riding saddles; power trace-trimmers; power trace-polishers; power splitters; and dieing-out machines. This list takes no account of the many smaller but important tools. Of these a great number could be mentioned.

In 1863 Barbour Brothers established at Paterson, N. J., the first factory for making harness threads in this country, all this product previous to this time having been imported from Ireland.

The introduction of hard-rubber-covered harness trimmings was an event of note. Mr. Andrew Albright, of Newark, N. J., patented this process in 1867. It is purely an American invention, and has figured conspicuously as a mounting for fine harness.

In the manufacture of horse-collars great progress was made. Many experiments were undertaken to stuff horse-collars by machine, but all efforts seemed futile. It was commonly held that such a thing could not be done. Old-line collar makers insisted that to stuff a collar by machine involved so many difficulties that only an exceedingly visionary person would ever seriously consider the scheme. As usual, the seemingly impossible was accomplished. The successful inventor in this instance was William Foglesong, living in Dayton, O., who took out his first patent in 1883. By the use of his machine an immense stride was taken in the manufacture of collars. Large establishments absorbed the many small and insignificant collar-shops. The old slow and laborious hand process gave way to the rapid machine method, its products being astonishingly smooth. It quickly won a place with the trade.

No other improvements of special note were made until the year 1892, when R. Brownson, of St. Paul, Minn., invented a metal-staple machine for sewing collars with metal staples. This was a great innovation in the manner of preparing collars ready for the stuffing-machine, and the rapidity with which this work can be done is marvelous. A set of these machines will do as much work as was formerly done by twenty men.

Machinery, push, and enterprise had by this time raised the business of making harness and saddlery goods from a position of inferiority to a commanding place among the industries of the land. A glance at the brief statistics following will convey some idea of the present proportions of this trade.

The number of establishments was 7931; the number of employees, 30,326; the total wages, $16,030,845; and the total value of products, $52,970,801. We have only returns as to investment from 159 cities over 20,000 population. It amounted to $20,618,104.

By comparison with the returns of the previous decade, which included 7999 establishments, with a total product of $38,081,643, it will be seen that the value of the output the last census year was $14,889,158 more than in the year 1880. It might be interesting to compare the total products of some of the principal cities of the United States, which are as follows:

COMPARATIVE PRODUCTION BY SELECTED CITIES.

Cities.	1880.	1890.
Chicago	$746,247	$1,486,256
Baltimore	857,810	923,503
Louisville	882,542	1,572,658
Newark	1,880,404	1,323,635
New York	1,037,768	1.824,729
St. Louis	2,364,858	2,803,961
Cincinnati	1,155,564	3,636,707

The fever of combinations, trusts, and associations which was spreading throughout the country reached the saddlery manufacturers in 1890, and a move toward organization for conference and mutual improvement was made in that year. The Western manufacturers called a meeting at St. Louis, at which a few manufacturers were represented. An organization was formed which called itself "The National Wholesale Saddlery Association of the United States." The object of the association, as agreed upon at the first gathering, was to correct abuses, adopt uniform terms, and to encourage a fraternal feeling among competitors. Annual meetings and elections were held, and men prominent in the trade were chosên as presidents. A list of those who have been successively elected is as follows:

A. F. Risser, of A. F. Risser & Company, Chicago, Ill.; Owen Gathright, of Harbison & Gathright, Louisville, Ky.; B. W. Campbell, of Perkins, Campbell & Company, Cincinnati, O.; J. S. Medary, of the Medary-Platz Company, La Crosse, Wis.; I. S. Gordon, of the Gordon-Kurtz Company, Indianapolis, Ind.; Albert Morsbach, of Graf, Morsbach & Company, Cincinnati, O.

The last meeting was held in the city of New York, July, 1895, when about fifty manufacturers were added to the membership, making a total of 175 to date.

Albert Morsbach

CHAPTER LXXXIX

THE FUR TRADE

VARIOUS species of animals which inhabit cold climates have a covering upon the skin called fur, coexistent with another and longer covering called the over-hair. The fur differs from the over-hair in that it is soft, silky, curly, downy, and barbed lengthwise, while the over-hair is straight, smooth, and comparatively rigid. Owing to the peculiar properties of fur, it is rendered valuable for the purposes of felting, while silk and wool, which it in some measure resembles, are not well adapted to felting, but must be spun or woven. The over-hair gives the distinctive peculiarity to the various furs, and contributes much to their marking and beauty. Fancy fur is that kind of fur that is considered in connection with and as a part of the pelt, while staple fur is fur that is useful apart from the pelt in the manufacture of the various felts. The manufacture of fur into felt is of comparatively modern origin.

The use of fur pelts as a covering for the body of man is not and was not necessarily a barbarous expedient utilized for want of something more civilized. It is to be noted that the utmost perfection to which the manufacture of woolen garments has been brought does not admit of their substitution for the pelts and furs of animals in high latitudes. The scientific explorers from the centers of civilization take a leaf out of the Eskimo's book and array themselves, as he does, in garments taken from the backs of the native animals. There is good reason for this. The pelt or skin acts as a shield against the driving storm of rain, snow, or hail, while the fur keeps out the piercing cold. Used thus in certain localities as a necessity, furs as apparel have developed into a luxury for the fashionable and wealthy. To supply the demand for furs in earlier times led to troubles among the Indian tribes, and to fierce quarrels and bloodshed among the members of different nations. Furs have played their part in history, and take their place alongside of precious gems, gold, and jewels in the field of ornamentation. Marco Polo has described with enthusiasm the elegant and sumptuous furs worn by the khan of Tartary. They have always played an important part in the decoration of Russian royalty and nobility. They are interwoven with the history of the French and English in Canada, and exerted an important influence upon the early history of New England, New York, and Virginia.

The history of furs is so interwoven with romance that it is difficult to break away from that branch of the subject. The adoption of fur robes by the Venetians was the evolution of the semi-Turkish dresses of the sixteenth century, which gradually merged in the gorgeous fur costumes of the Renaissance; and an ancient diary tells how "ten mules carried the boxes which contained the furs belonging to my lady the duchess [Lucretia Borgia], the majority of which came from the East." The origin of the term "ermine" is interesting from the fact that it was based on a mistake. A recent writer explains that "the Byzantine emperors exacted from the conquered or tributary princes an annual tribute of furs and skins of beasts, and undoubtedly it is to them that we owe the introduction of the ermine as a royal fur. The Greeks, who were very fond of ermine, believed it to be the skin of a white rat. . . . The Byzantines called it the Armenian rat-fur—hence the word 'hermine' or 'ermine'; and until quite late in the seventeenth century it was always termed in France *le rat d'Arménie*." The ermine is of the same family as the English stoat, and its beautiful whiteness is due to the high northern latitude which forms its habitat. It is stated that the late czar of Russia had coronation robes made out of no fewer than 250,000 ermine-skins. "Miniver" is ermine spotted with astrakhan, and "Théophile Gautier, in an essay on Cinderella, assures us that young lady's famous glass slipper was not made of glass at all, but simply lined with *ver* or miniver, wrongly interpreted as *verre*." Ermine became a

"royal" fur by decree of Edward III. of England, who also regulated the wearing of furs by his subjects. He decreed that "no person whose income did not amount to £100 a year should wear furs, under penalty of forfeiting them." A letter from Margaret Bryan—who was governess to the children of Catherine of Aragon, Anne Boleyn, and Jane Seymour—to the king asks that money be sent her, as the garments of his Grace, Prince Edward, "are barely decent, and he much needs a fresh set of furs, his being mangy."

Of all industries that of manufacturing the pelts of animals into articles for the use of mankind is the most ancient, and hardly a country exists in which, to some extent, the skins of different beasts are not so used at the present time. The manufacturing of skins into articles of apparel and luxury is an industry apart from all others, and one requiring great knowledge and experience, as the stability as well as the appearance of most furs depends much upon the mode of curing, drying, and making up. From the Arctic circle, where furs are a necessity of existence, to the tropics, and again southward into the Antarctic regions, the furs of wild animals have from time immemorial contributed to the needs and the comfort of mankind; and even in the temperate zone we have learned, from the sudden changes of temperature to which the vagaries of our climate subject us, thoroughly to appreciate the luxury and utility of furs. The rich peltries of North America were the magnet, holding forth the promise of commercial gain, that drew hitherward the pioneers and precursors of civilization. But for the hardy and adventurous Frenchman and Briton who early sought fortune in the traffic in furs, the settlement and advancement of the country would have been much delayed, as it is only after the path through the wilderness has been blazed that the somewhat timorous steps of agriculture and civilization can be led into a newly discovered region. In the early days the fur trade played a most important part in the settlement of the country, those engaged in it journeying into the most distant and inaccessible parts, and being the founders of very many of the first settlements; in fact, the fur traders are to be regarded as the chief pioneers of North America. Important as the business was even in those days, the more general use of furs has made it at present one of the most important factors of our trade and commerce.

The Canadian provinces owe their first start on the road to prosperity to the fur trade. The stimulus of gold mining was lacking there, and in seeking for an outlet for their energy the French pioneers discovered that as the Indians were ignorant of the value of the furs which they accumulated, an enormous profit was possible to the successful trader in those articles. In the infancy of the industry there was absolutely no limit to the percentage of profit, as the Indians would exchange the most valuable of peltries for European trinkets that were worth nothing except the cost of transportation. The trade in furs with the natives soon created a class known as *coureurs des bois*, or rangers of the wood, whose untamable licentiousness brought scandal upon the traffic, and led to the licensing system, which itself soon became subject to abuse. During twelve or more months these men would be absent from the trading-posts, when they would return with canoes laden with packs of beaver and other skins, with the proceeds of the sale of which they would indulge in the most extravagant dissipation. Their funds would thus soon become exhausted, and they would again disappear on a voyage for subsistence.

The British merchants of New York soon began to encroach upon the business of the Canadian traders, which led to bitter feuds regarding the infringement of territorial rights; and matters were still more complicated upon the formation of the Hudson's Bay Company, which was chartered by Charles II. in 1670, having the exclusive privilege of planting trading stations on the shores of Hudson's Bay and its tributaries. When, in 1762, France lost possession of Canada, British subjects gained almost exclusive control of the fur trade. Prior to 1795 the trade was almost wholly monopolized by great trading companies, the Dutch East India Company having been first in the field, with trading-posts at New Amsterdam (New York), Beaverwyck (Albany), and several points on the Delaware and the coasts of Maine. The Hudson's Bay Company for almost two hundred years monopolized the trade in furs, although after 1790 it had a somewhat powerful rival in the Northwest Company. In 1805 the latter company established trading-posts on the Pacific coast. In 1808 John Jacob Astor established the American Fur Company, with its line of posts across the continent, intending to form a depot for furs at the mouth of the Columbia River, and to ship the furs directly to China and India from that point. He subsequently changed its name to the Pacific Fur Company, and was on the highroad to success, when, in 1813, his resident partner there treacherously sold out the whole establishment to the Northwest Company, on the plea that the British forces, with whom we were then at war, would have

captured it. The Russian-American Fur Company, having its trading-post at Sitka, in Alaska, and subordinate posts on the Yukon, carried on an immense traffic for many years, but in 1867 transferred its property and rights to the United States, simultaneously with our purchase of Alaska. Mr. Astor, after the treacherous transfer of the Pacific Fur Company to the Northwest Company, confined his operations to the region east of the Rocky Mountains, and with his partner and successor, Mr. Ramsay Crooks, transacted for many years a profitable business in furs.

The name of John Jacob Astor is so interwoven with the history of the fur trade of America that I deem it appropriate at this point to glance briefly at the career of that remarkable man. He was born in Walddorf, near Heidelberg, Germany, July 17, 1763, and his death occurred in New York, March 29, 1848. He sailed for Baltimore in 1783, with a quantity of musical instruments to sell on commission. One of his shipmates was a furrier, who excited young Astor's imagination by stories of the large profits made by purchasing furs from the Indians and trappers and selling them to the wholesale dealers. Arrived in New York, he entered the establishment of a Quaker furrier, in order to familiarize himself with the details of the trade. On his return to New York, after a visit to Europe, he opened a warehouse for the sale of musical instruments, which was the first regular house of the kind in America. It was about 1809 that he conceived his great scheme to render American trade independent of the Hudson's Bay Company, and to spread the civilization of the East throughout the country. To carry out this scheme he asked the aid of Congress. His idea was, briefly, to establish a chain of trading-posts from the lakes to the Pacific Ocean, with a great central depot at the mouth of the Columbia River; to acquire one of the Sandwich Islands, and establish a line of vessels between the west coast of America and the Indian and Chinese ports. Expeditions were sent out, and in 1811 the settlement of Astoria was formed at the mouth of the Columbia, but was abandoned, owing to the War of 1812. Irving's "Astoria" gives a graphic description of the gigantic enterprise. Mr. Astor extended his fur business widely, establishing trade with many countries. The last twenty-five years of his life were passed in retirement. At the suggestion of Washington Irving he left $400,000 for founding the Astor Library. His fortune at the time of his death was estimated at $20,000,000. William Backhouse Astor, the son of John Jacob, was interested with his father in the fur trade, and when, in 1827, the firm of John Jacob Astor & Son was merged in the American Fur Company, he became its president. He retired from business, however, before his father's death, and succeeded to his vast fortune.

St. Louis was one of the principal depots of the fur trade from 1763 to 1859. The first great establishment there was founded by Laclede, Maxon & Company in 1763. The brothers Auguste and Pierre Chouteau were connected with it very early; up to 1808 they employed a large number of trappers and voyageurs, and were very successful. In 1808 the brothers Chouteau and several of their associates formed the Missouri Fur Company, which prospered greatly until 1813 or 1814, when, in consequence of the war with Great Britain, it was dissolved, and several of its members conducted the business independently. In 1827 the Rocky Mountain Fur Company, of St. Louis, was formed, and sent its trappers to the Pacific coast. The perils of the business were very great, forty out of every hundred men perishing in its service; but such was the fascination of this life of adventure that enough were always ready to supply the places of the slain. After some years of successful business this company was dissolved. In 1834, Pierre Chouteau, Jr., who had been brought up in the business with his father and relatives, organized the firm of Pierre Chouteau, Jr., & Company, a name which for the next twenty-five years was familiar to all the trappers and hunters from the Mississippi and the Great Lakes to the Pacific. In 1859 the business was sold to Martin Bates and Francis Bates, of St. Louis and New York. After the consolidation of the Northwest Company with the Hudson's Bay Company, in 1821, and the expiration of the latter's charter and license in 1859, the fur trade became more widely diffused in the hands of individuals. While the aggregated amount collected each year is much greater than it was forty years ago, the opportunities for acquiring colossal fortunes in the trade have gone. Furs are made up now at more than twenty points in the North and West, and London and Leipsic are becoming the best markets for the sale of American furs, as they have long been for those of Europe, Asia, and South America. While the trade in furs in the United States of late years has been very extensive, it has, in a large measure, been the result of individual enterprise rather than that of gigantic corporations. The ancient monopolies of the fur trade have died a natural death, and the immense business in fancy furs alone proves that

individual enterprise has taken every advantage of its opportunity.

A writer in "Silliman's Journal" for January, 1834, gives such a lucid review of the fur trade at that time that I feel that it will be instructive to quote a portion of it here. He says:

"The Northwest Company did not long enjoy the sway they had acquired over the trading regions of the Columbia. A competition, ruinous in its expenses, which had long existed between them and the Hudson's Bay Company ended in their downfall and the ruin of most of the partners. The relict of the company became merged in the rival association, and the whole business was conducted under the name of the Hudson's Bay Company.

"This coalition took place in 1821. They then abandoned Astoria, and built a large establishment sixty miles up the river, on the right bank, which they called Fort Vancouver. Mr. Astor has withdrawn entirely from the American Fur Company, as he has, in fact, from active business of every kind. That company is now headed by Mr. Ramsay Crooks. Its principal establishment is at Michilimackinac, and it receives its furs from the posts depending on that station, and from those on the Mississippi, Missouri, and Yellowstone rivers, and the great range of country extending thence to the Rocky Mountains. This company has steamboats in its employ, with which it ascends the rivers, and penetrates to a vast distance into the bosom of those regions formerly so painfully explored in keel-boats and barges, or by weary parties on horseback and on foot.

"In addition to the main companies already mentioned, minor associations have been formed, which push their way in the most intrepid manner to the remote parts of the far West, and beyond the mountain barriers. One of the most noted of these is Ashley's company, from St. Louis, who trap for themselves, and drive an extensive trade with the Indians. The spirit, enterprise, and hardihood of Ashley are themes of the highest eulogy in the far West, and his adventures and exploits furnish abundance of frontier stories.

"Another company of 150 persons from New York, formed in 1831, and headed by Captain Bonneville, of the United States army, has pushed its enterprises into tracts before but little known, and has brought considerable quantities of furs from the region between the Rocky Mountains and the coasts of Monterey and Upper California, on the Buenaventura and Timpanogos rivers.

"The fur companies from the Pacific east to the Rocky Mountains are now occupied (exclusive of private combinations and individual trappers and traders) by the Russians, and on the northwest from Bering's Strait to Queen Charlotte's Island, in north latitude fifty-three degrees; and by the Hudson's Bay Company thence, south of the Columbia River; while Ashley's company and that under Captain Bonneville take the remainder of the region to California. Indeed, the whole compass from the Mississippi to the Pacific Ocean is traversed in every direction. The mountains and forests, from the Arctic Sea to the Gulf of Mexico, are threaded, through every maze, by the hunter. Every river and tributary stream, from the Columbia to the mouth of the Rio del Norte, and from the Mackenzie to the Colorado of the West, from their headsprings to their junction, are searched and trapped for beaver. Almost all the American furs which do not belong to the Hudson's Bay Company find their way to New York, and are either distributed thence for home consumption or sent to foreign markets.

"The Hudson's Bay Company ship their furs from their factories of York Fort and from Moose River, on Hudson's Bay; their collection from Grand River, etc., they ship from Canada; and the collection from Columbia goes to London. None of their furs come to the United States, except through the Indian market.

"The export trade of furs from the United States is chiefly to London. Some quantities have been sent to Canton, and some few to Hamburg; and an increasing export trade in beaver, otter, nutria, and vicugna wool, prepared for the hatter's use, is carried on in Mexico. Some furs are exported from Baltimore, Philadelphia, and Boston; but the principal shipments from the United States are from New York to London, from whence they are sent to Leipsic, a well-known mart for furs, where they are disposed of during the great fair in that city, and distributed to every part of the Continent.

"The United States import from South America nutria, vicugna, chinchilla, and a few deerskins; also fur-seals from the Lobos Islands, off the river Plate. A quantity of beaver, otter, etc., is brought annually from Santa Fé. Dressed furs for edgings, linings, caps, muffs, etc., such as squirrel, genet, fitchskins, and blue rabbit, are received from the north of Europe; also cony and hare's fur; but the largest importations are from London, where is concentrated nearly the whole of the North American fur trade."

Even at this date it was feared that the fur trade must rapidly decline, as there were no new countries

to be explored, and the indiscriminate slaughter practised by the hunters bade fair to exterminate fur-bearing animals. In many cases this fear has proved to be without foundation. Many fur-bearing animals have increased in numbers, especially the small mammals, which seem to thrive in the neighborhood of settlements, feeding on the farmers' crops; but others, especially the larger species, such as bears, beavers, etc., are much reduced in numbers, though it is to be hoped that they will not meet the fate of the buffalo (*Bison Americanus*), which is now reduced to a few scattered herds in southern Canada and the Yellowstone Park, probably numbering less than 500 all told in the United States. Up to 1875 these animals, whose skins were an important commodity in the trade, existed in countless herds on the Western plains, and were valuable alike to the Indian and the white man, whose needs, in the way of food and clothing, they supplied. From 1871 to 1874 it is estimated that between 4,000,000 and 4,500,000 of these animals were recklessly killed, merely for the sake of their hides. The extinction of the buffalo has created among the Indians a need which must now be supplied by the United States government in the shape of meat rations. The Indians excel all others in dressing the skin. The head of the male buffalo is in great demand at present as a mural ornament. The valuable fur-seal bids fair to follow the buffalo into the shades of oblivion; but as neither of these useful fur-bearing creatures is actually extinct I have included them in the following table of

PRINCIPAL AMERICAN FUR ANIMALS.

Common Name.	Scientific Name.	Habitat.	Color.	Uses.
Beaver	Castor fiber	N. America, N. Europe, Asia	Chestnut brown	Muffs, trimmings, robes.
Silver fox	Canis vulpes	Northern latitudes	Silver gray	Muffs, trimmings, boas, robes.
Cross fox	"	" "	"	"
Red fox	"	" "	Red	"
Arctic fox	"	" "	White	"
Blue fox	"	Alaska, Greenland	Slate or purple	"
Gray fox	"	Virginia	Gray	"
Racoon	Procyon lotor	N. America	Grayish yellow	Robes, rugs, gloves.
Wolverene	Gulo luscus	N. America, Europe, Asia	Dark brown	Robes, muffs, trimmings.
Fisher	Mustela pennanti	N. America	"	Muffs, boas.
Mink	Mustela vison	High latitudes	"	Muffs, boas, capes.
Lynx	Felis Canadensis	N. America, Europe	Silver gray	Robes, muffs, boas, collars.
Wildcat	Felis rufa	N. America	Yellowish brown	Robes.
Skunk	Mephitis mephitica	N. America	White and black	Muffs, collars.
Black bear	Ursus Americanus	Northern latitudes	Black	Rugs, robes.
Cinnamon bear	Ursus cinnamonum	" "	Dark brown	"
Grizzly bear	Ursus ferox	" "	Brown	"
Polar bear	Ursus maritimus	High latitudes	White	"
Isabella bear		Northern latitudes		Ladies' goods.
Badger	Taxidea Americana	N. W. America	Sandy gray	Painters' brushes, muffs, boas.
Sea-otter	Enhydris lutris	N. Pacific	Dark brown	Coats, muffs, collars, caps.
Otter	Lutra Canadensis	N. America, Europe	Chestnut	Muffs, collars.
Fur-seal	Callorhinus ursinus	Alaska, Shetland	Yellowish gray	Mantles, cloaks.
American wolf	Lupus Occidentalis	N. America	Black, gray, white.	Robes, rugs.
Prairie-wolf	Lupus latrans	"	Dark gray	"
Panther	Felis concolor	All America	Light dun	"
Musk-ox	Ovibos moschatus	Upper Canada	Dark brown	Sleigh-robes.
Buffalo	Bison Americanus	N. W. America	Drab brown	Robes, coats.
Marten	Mustela Canadensis	N. America	Light brown	Coat lining, capes.

The fur-seal is of paramount interest to the trade. There are many varieties, but four of which are extensively used by the trade, viz., the Alaskan, Victoria or Northwest coast, Copper Island, and Lobos Island.

The Alaskan fur-seal fishery is the most extensive in the world. It was a material element in the value of that province when purchased by the United States from Russia at a heavy cost, and one of the principal inducements upon which the purchase was made. Since Alaska became the property of the United States this fishery has afforded a very considerable revenue to the government by the lease of its privileges, and has engaged a large amount of American capital and the industry of many American people. The product is an important article of commerce and of manufacture, a substitute for which could not easily be found.

For sixty years prior to 1862 these fisheries had been leased by the Russian government to the Russian-American Company, a corporation composed mainly of Siberian merchants; but upon the

sale of the province to the United States government the latter became possessed of all its rights there. Even at that time the question of the reduction of seal and their subsequent extinction was being agitated, and soon after acquiring the territory Congress passed laws forbidding the killing of seal upon the islands of St. Paul and St. George, except during the months of June, July, September, and October; prohibiting the killing of females and the use of firearms, none under one year old to be killed, and none to be taken in the adjacent waters or on places where they haul up to remain; also limiting for twenty years the number to be killed on these islands to 100,000 annually, reserving the right to restrict the number if at any time it appeared necessary or advisable to do so in order to prevent serious reduction of the species. In 1870 the Alaska Commercial Company obtained its lease, expiring May 1, 1890, at a rental of $50,000 per annum and $2 revenue for each seal taken. The headquarters of this corporation were in San Francisco, John F. Miller, afterward Senator from California, being the first president, succeeded by Mr. Lewis Gerstle, one of the original stockholders. The affairs of the company were principally managed by Messrs. Gerstle, Sloss, Niebaum, and Neumann on the Pacific coast, by Mr. Hutchinson at Washington, and by Sir Curtis Lampson (since deceased) in London. The number of seals taken by the company during its lease has been startling in its magnitude, and the amount of rent and revenue paid to the United States has corresponded with it.

During the last year of the lease the company was restricted to 60,000 skins, but took only 21,000. At the expiration of the term of the Alaska Commercial Company the North American Commercial Company succeeded in obtaining the lease from the government for the ensuing twenty years, expiring 1910. The government leased to the North American Commercial Company, for twenty years from May 1, 1890, the exclusive right to take seals in Alaska Territory, for an annual rental of $60,000 and a tax of $2 upon each fur-seal taken. It is claimed that during the year ended on April 1st last 16,031 skins were taken. At the present time the case of the United States against the North American Commercial Company of California to recover $214,293.37, alleged to be due on the contract since April 1, 1895, is pending in the United States Circuit Court. The case is regarded as one of great importance.

The first seals to arrive at the Pribylov Islands are the bulls, each one of which immediately locates for himself and future harem a homestead averaging about ten feet square. At first, when they are merely straggling in,—that is, about the 1st to 5th of every May,—the competition among them is not great; but later, when the breeding grounds are becoming more crowded, the efforts of late comers to oust those who have already ensconced themselves result in the most terrific combats, attended with great mutilation and sometimes death. The bulls who do not succeed in obtaining places are obliged to separate themselves from the others. They are mainly those from five years old and under, though some old bulls weakened by age or combat are included in the number. They are called "bachelor seals" by the whites and "holluschickie" by the Aleuts. They number from one third to one half of the whole aggregate of seals at the islands. It is from these bachelor seals that the lessees of the islands take the skins, which are shipped in batches of 200 to 300 casks through San Francisco and New York to London, where they are subsequently sold at public auction at the great "sales" there. Each cask contains forty to forty-five skins, rolled up separately, tied with cord, and packed in salt.

The seals are not killed at the rookeries, but are driven up to near the villages. At daybreak, while the seals are still asleep, a few natives, by stealing along the shore, can turn thousands of the "bachelors" back inland. They walk behind and on the flanks of the herd, and drive them to the killing grounds. This is done slowly, and frequent opportunity is given them to rest and cool off, as the seal is unwieldy and makes very hard work of traveling on terra firma. If they become overheated the fur suffers injury; but notwithstanding all the care taken in driving them, many become exhausted and die on the march, especially the old full-sized bulls or such as may have been injured in combat. As far as possible in starting these drives, the natives select seals about three to four years old, as at this age the fur is at its best. Old bulls are allowed to fall behind on the march and make their escape, as their skins have no commercial value to speak of. Upon arriving at the killing grounds they are permitted to rest for an hour or two, after which the killing takes place. Each member of the killing gang carries a long club, a skinning-knife, and a whetstone. About 100 to 150 of the corralled seal, making what is termed a "pod," are driven out at a time from the others, and after the chief has indicated such as are not to be killed (being too old, or perhaps having been bitten), the others are slaughtered by blows on the head with the clubs, and by

F. Frederic Gunther.
(died December 3, 1895.)

incisions with the knives, after which the skins are removed as quickly as possible, to avoid "heating." The Victoria fur-seal, of which so much has been heard of late years through the recent diplomatic controversy and subsequent arbitration with Great Britain before the Paris tribunal, is next in importance.

Most of the vessels engaged in this fishery are owned by Canadians. Many of them carry Indians, who are very experienced hunters. When a herd of seals is discovered a canoe is launched. If the animals are asleep they are approached as quietly as possible and speared, otherwise they are shot; but in the latter case many are lost, as they are apt to sink before the canoe can reach them. The Victoria seals taken are chiefly females, with the exception of a few old bulls, and are generally captured at a rather earlier period of the year than the Alaska seals.

During the past few years the government has restricted the lessees of the Alaska seal-fisheries to a limited catch each year. The following table shows the restriction and the number taken.

FUR-SEALS TAKEN.

Year.	Catch Restricted to	Number Taken.
1890	20,000	....
1891	....	....
1892	....	7,500
1893	....	7,500
1894	7,500 to 20,000	16,000
1895	7,500 to 15,000	15,000

As the matter now stands, the government annually fixes a maximum and minimum number which may be killed, and before the season opens the exact number allowed is fixed upon by an agent stationed at the Alaska fisheries.

Copper Island seals are taken on one of the islands of the Aleutian group, called "Copper Island," which is still the property of Russia, close to Kamchatka. The fur is inferior to that of the Alaska seal, although it is probably the same animal taken at a different season of the year. The color is also lighter, being usually dark brown, and the fur not generally of such good quality. The quality of the fur, owing probably to climatic influences and nature of food, varies considerably, being sometimes equal to the Alaska, and at others vastly inferior. The yearly catch of these skins is about 40,000 to 50,000.

The decision of the Bering Sea Court of Arbitration was made public at Paris on August 15, 1893. A close season was established, to begin May 1st and to continue until July 31st; this season to be observed both in the north Pacific Ocean and in Bering Sea. A protected zone was established, extending for sixty miles around the islands. Pelagic sealing was allowed outside the zone in Bering Sea from August 1st. The use of firearms in sealing was prohibited. In spite of these precautions it is generally conceded that the Paris Court of Arbitration was a signal failure as a means of preventing the extinction of the seals. So alarming has been the slaughter of seals in northern waters that recently an important step has been taken in the direction of discovering new fields. Governor Sheakley, in a report submitted to the Secretary of the Interior, in October of this year, on the condition of affairs in Alaska Territory, says the extinction of the sea-otter and other fur-bearing animals in that region is inevitable. Speaking of the rapidly diminishing seals, he says that the official inspection of skins taken by pelagic sealers last year showed anywhere from fifty-five to eighty per cent. of female skins, thus confirming previous investigation on this point. The governor explains that so long as buckshot is being picked from the hides of young males killed in the Pribylov Islands, and maimed and wounded seals limp about the hauling grounds, and so long as from fifty-five to eighty per cent. of the pelagic catches sent to London are females (none of which is ever taken on the islands), it is needless to inquire further for the cause of demolition of the seals, both upon the hauling and the breeding grounds. He did not see anything in the method of handling seals at the islands which would warrant the views as to decadency presented in the British case. The rehabilitation of the rookeries would be an easy matter if adequate protection were afforded the females. He states that better protection than that afforded by the findings of the Paris tribunal will be necessary for their restoration.

The catch along the northwest coast by American vessels the last spring, Governor Sheakley says, did not reach 100 skins per schooner, while the British average was about 200. Great Britain gave to the Canadian sealers increased facilities by availing herself of a technicality and violating the clear intent of the Paris regulations relating to firearms. The governor recommends that the Treasury Department issue such instructions as will insure the taking, between the 1st of June and the 10th of August of each year, of every marketable sealskin on the Pribylov Islands.

I am led to enlarge somewhat upon this question of the Alaskan fur-seals from its manifest importance to the fur industry, seal-fur being at once the most useful and the most popular of all furs. In September of this year Assistant Secretary of the Treasury Hamlin received from Agent Crowley, stationed on the Pribylov Islands, a report to the effect that the lessees were permitted by him to ship 15,000 skins for the season, this figure being the maximum set by the department. In connection with this report Mr. Hamlin is reported to have said:

"Mr. Crowley was permitted to allow a catch of 15,000, including all the skins left over from last season, if in his judgment the condition of the herd on the islands would warrant it. The reports previously received indicated that a considerable number of skins were left over from last season, which have been counted in this year's catch; and, in addition, we assume that the 15,000 will be found to include a considerable number of young male seals, so that it will hardly be safe for the trade to count on 15,000 full-grown skins. While it had been assumed that owing to the reports from the coast Mr. Crowley would only permit 7500 to be taken, it should be remembered that a 15,000 catch is really very small indeed, and would be wholly insignificant if the seal-herd were not being depleted so rapidly. You will remember that under the *modus vivendi* 7500 seals were permitted to be taken by the natives for food. I cannot now say exactly what the department will do during the coming winter, but no effort will be spared to save the remnant of the herd."

It is of interest to note that for some years after the discovery of the sealing grounds of Alaska by Pribylov, in 1786, the slaughter of seals was unprecedented. In the year following the discovery, 500,000 seals are said to have been killed by the Russian hunters. The natural result followed, and in 1807, when the order was issued to kill no more seals for five years, the herd was on the verge of extinction. That the slaughter of seals progressed at the rate of 100,000 a year for twenty years after the acquisition of Alaska by the United States, is proof of the wonderful recuperative possibilities of these animals, and an earnest and honest effort on the part of the nations interested might yet save from extinction this interesting herd of mammals.

It is not for sealskins alone that the fur trade is indebted to Alaska. That territory sends its quota of the pelts of the sea-otter, the land-otter, the beaver, brown bear, black bear, fox, mink, marten, lynx, wolf, muskrat, and wolverene. The total value of furs shipped from Alaska and Russian America from 1745 to 1890 amounted to $93,102,970. The number of Alaska fur-seal skins sold in London from 1868 to 1890 inclusive was 2,411,099. Of these the Alaska Commercial Company shipped 1,861,052 (salted), other traders 412,254 (salted). Of dried furs there were 50,288, and of dressed, 87,505.

In reviewing the fur trade of the United States it is impossible to ignore the relationship that it bears to that of other countries. Many of the great American houses have partners resident in London and Leipsic and in other parts of the world. London is still the great fur auction mart of the world, although America leads all countries in the art of manufacture, furs in the raw state being admitted here duty free. Leipsic still holds spring and autumn fairs, in which exchanges are made of Leipsic wares for the skins from Russia, Austria, and Turkey. The chief fur fair of European Russia is held at Nijni-Novgorod. Siberia exchanges furs with China for commodities, and a fair for the purpose is held annually at Kiakhta. Staple furs, used largely in the making of hats, are principally those of the hare and rabbit, and come from France, Russia, Germany, England, the western part of America, and from Australia.

The preparation of most skins for packing and transportation is by no means so difficult as might appear. After being stripped from the animal they are carefully cleaned of fat and flesh, and dried in a cool, dry place. When thoroughly dry they are ready for shipment. This method does not apply to the fur-seal, which is an exception to the rule, the manner of packing which is told elsewhere.

The variety of furs is so great, and the cost so variable on account of the fickleness of fashion, that the record of consumption is never the same for two years running. Some of the most exquisite of the peltries are obtained from animals whose habitat is in regions remote and uncultivated. That all of those kinds having the most beautiful fur are not exterminated is due to the sudden and unaccountable changes in fashion. The demand for a certain class of fur ceases for a season or two, and with it ceases the destruction of the animals, who thus have a period in which to recover their normal status as to numbers. A record of the annual collection of furs in America is at best far from reliable, except as to the year to which it refers. The following list is as accurate an average as can be obtained from the data available.

AVERAGE ANNUAL COLLECTION OF AMERICAN FURS.

Badger	5,000
Bear	15,000
Beaver (formerly)	200,000
Buffalo (bison) (formerly)	100,000
Fisher	12,000
Fox, silver (Asia and America)	2,000
" cross (Asia and America)	10,000
" blue (Europe and America)	7,000
" red	60,000
" gray	30,000
" kit	40,000
Marten	130,000
Mink	250,000
Muskrat	3,000,000
Opossum	250,000
Racoon	500,000
Sea-otter	2,000
Skunk	550,000

Following the rule that applies to all modern business and professions, the fur trade has been split up into departments, and very few firms carry on all the branches of the business, as was formerly done, under one roof. The taxidermist may be said to conduct a collateral branch of the fur industry. The manufacturing furriers and fur dealers represent an enormous investment of capital, and most of them are importers and exporters as well. There are a large number of important manufacturing firms in America, notwithstanding the hold on that branch held by London and Leipsic, and furs made here are, as a rule, of superior manufacture. In 1890 the whole number of establishments handling fur goods in the United States was placed at 484. These firms paid $4,749,191 in wages to 8075 employees. The cost of materials used amounted to $11,742,508, and the value of products, including receipts from custom-work and repairing, is set down as $20,526,988. That New York is the great center of the American fur industry is shown by the fact that her proportion of the above totals for 1890 was as follows: establishments, 281; employees, 4983; wages, $3,113,762; cost of material used, $6,897,-292; value of product, $12,434,272. These figures show that New York does considerably more than half of the entire fur business of the country. Of the value of Alaskan business I have spoken elsewhere. Of the Western States, Minnesota makes an excellent showing, with 25 establishments, employing 488 persons, whose wages amount to $276,393. The cost of materials is $727,117, and the value of the product $1,152,369. These figures apply to 1890.

The manufacture of hats and caps can only be referred to as a branch industry allied to the fur trade, inasmuch as the felt is made from fur. Of course there are hats and caps made directly of fur, which come within the province of the furrier. The passing of the beaver hat appears to be permanent, although that species of head-gear had a temporary revival during Mr. Harrison's presidential campaigns. The relative value of the beaver and silk hat is thus written about by George Augustus Sala:

"Let us now take the case of men's hats. The costliest hat, in my youth, was the beaver one. The last occasion when George IV. was seen in public was at Ascot races in 1828 or 1829. He wore a brown beaver hat, and brown beavers for a season or two were fashionable; but ultimately the black or the gray beaver resumed its sway. The very best ones were made entirely of the fur of the beaver, and cost from three to four guineas. A second-class beaver consisted of a body or foundation of rabbit's fur, with a beaver nap; but the latter was frequently mixed with some other fur. This article could be purchased for a guinea or thirty shillings.

"The life of a real beaver hat extended over about three years; the adulterated article wore out in about a twelvemonth; whereas the most economical of gentlemen at present can rarely consume less than four silk hats a year. If he pays ready money for his hats he may obtain them for a guinea each, so that he stands, financially speaking, in a position worse than that of a gentleman of the Georgian era, whose genuine beaver cost four guineas, but lasted four years.

"This is one of the instances in which modern cheapness is only apparent."

It would, of course, be impossible in this article to go into details regarding the processes of manufacturing furs. As a guide to the subject generally I will briefly outline the process by which the skin of the fur-seal is made ready for the market. These skins, on their arrival at the furrier's, packed in salt, are both evil-smelling and unsightly. The first step is to remove the salt by washing. The fat or other extraneous matter adhering to the inside of the pelt is then carefully removed, after which the skins are stretched upon frames and slowly dried. They are next soaked in water and thoroughly washed with soap. The fur is then dried, leaving the skin moist. At this point the operator removes with a knife all of the long hair, leaving nothing but the soft underfur. This process is both tedious and delicate. The pelts are then subjected to moisture and heat on the skin side, and shaved until a smooth, even surface is obtained. The next process is that of drying and softening the skins. This is done by treading them with bare feet in tubs in which is a quantity of fine hard-wood sawdust, which absorbs any natural oil which may still adhere to the fur. The delicate

operation of dyeing next takes place, wherein the dye is applied with a brush to the points of the fur, which is then gently agitated to evenly distribute the coloring-matter. After drying and brushing, another coat is applied, and this is continued until eight to twelve coats have been given to the skin. At this point the English process ceases, but the American furriers continue to wash and dry the skins with sawdust after the application of the dye. This insures a beautiful, finished, and lasting product.

Mere mention of a tithe of the enterprising men who are making the fur trade what it is would be impracticable here, the business being so minutely subdivided, as I have before stated. The fur trade of the United States has in the past had associated with it many honored names. Among them were J. J. Astor, William B. Astor, John G. Wendel, Christian G. Gunther, Sir Curtis Lampson, Ramsey Crooks, Gabriel Franchere, J. Carson Brevoort, and Martin Bates. But few, however, of the fine old houses have lineal descendants at present engaged in the trade, which has passed largely into other hands. There are, in addition to the branches mentioned, jobbers of furs, proprietors of skunk farms, dealers in hatters' furs, fur sewing-machine houses, and firms making machinery and material used by furriers, such as muff-blocks, head-forms, skulls, and down muff-beds. All of these branches are represented by houses of enterprise and character. That there are dishonest and disreputable men in the trade, who thrive by dubious practices, is both true and regrettable. They do not last long, however, owing to the fact that their sin soon finds them out, and the customer once tricked by them is more careful in selecting a reputable firm for future dealing. The opportunities for trickery in the fur trade are limitless, and the wonder is that so few scamps have crept into it.

The volume of business shown by the exports and imports of furs can only be approximated as to the early years of the present century, except in regard to Alaska, where by means of the Russian and Chinese records it is tolerably complete for a period of more than a century. The following table gives the value of imports and exports of furs in this country from 1869 to 1894 inclusive:

FURS AND MANUFACTURES OF FURS.

Year.	Imports.	Exports.
1869	$3,094,115	$2,039,563
1870	2,236,229	1,941,139
1871	3,217,334	1,590,193
1872	3,503,176	3,343,005
1873	3,890,089	3,725,550
1874	3,379,288	3,334,365
1875	4,530,753	4,396,424
1876	4,551,372	4,398,883
1877	3,963,444	3,788,802
1878	3,944,270	2,618,100
1879	4,516,290	4,828,158
1880	6,424,112	5,404,418
1881	7,001,649	5,451,419
1882	8,030,970	4,747,944
1883	7,959,759	3,935,603
1884	8,178,124	3,998,182
1885	5,257,547	4,153,287
1886	6,813,887	3,321,102
1887	7,285,619	4,807,227
1888	6,735,344	4,777,216
1889	7,416,223	5,034,435
1890	7,553,816	4,661,934
1891	9,828,849	3,236,705
1892	10,197,131	3,586,339
1893	10,567,807	3,699,579
1894	7,620,284	4,238,690

The total domestic exports of furs and fur skins during August, 1895, amounted to $115,985, as against $60,851 for the same month of 1894.

In the interval snatched from business cares it is impossible to do anything like justice to this great subject. I have endeavored, however, to outline a few of its salient points. The difficulties and dangers attendant upon the securing of them lend to furs a sentimental value. They come from the frozen islands of the Arctic Sea, the barren wastes of northern Russia, and the jungles of Africa and India. They are hunted by sea and by land, on snow-shoes and under the equatorial sun. Comfort in furs lies in the use rather than in the pursuit of them. The historian of the American fur trade has before him a subject of entrancing interest. The furs which adorn the beautiful women of America, and ornament their homes, are part of the history of the country. They have been obtained at the expense of much human ingenuity, of marvelous endurance, and, in many instances, of the lives of the adventurous men who have borne the heat and burden of the day in order that our civilization might not lack one of the greatest requisites of elegance and refinement.

F. Frederic Gunther

CHAPTER XC

THE JEWELRY TRADE

THE manufacture of jewelry in this country is one of the oldest industries of which there is tangible record. It antedates the United States, the foundation of the colonies, and even history itself; for history takes us back only to the discovery of America in 1492, and it is merely a matter of speculation how many centuries previous to that the native Indians had lived on this soil. Next to his girdle of scalps the Indian loved nothing better than his beads and his necklaces of wampum and of bits of ivory, bone, and metal. These were his articles of personal adornment—our definition of jewelry. It is, then, to the native American Indian's love of personal adornment that we trace the origin of jewelry in America. The Indian chiefs covered themselves with the best that the handiwork of their tribes could produce, and we are told that their wrists, ankles, heads, ears, and even noses, all bore tribute to their vanity and their love for adorning their persons with trinkets, though they were entirely indifferent to our modern necessity of clothing.

The history of the early Dutch settlers informs us that they brought with them such articles as they needed for their personal adornment in the new settlements, and it is evident that they were as thoroughly human in this respect as all known races of the human family are reputed to have been; for from the very foundation of the colonies no one's attire was considered complete in the English-speaking towns without buckles, brooches, and rings made of the metals in vogue at that time.

These being the customs of the early settlers, the industry of gold and silver smithing was soon established, and by reference to the history of the three principal towns in the colonies we learn that in each there were numerous gold and silver smiths, whose principal products were medals and other trinkets for Indian chiefs, and snuff-boxes. The use of snuff was then universal, and every man took a pinch when proffered, whether he liked it or not. This usage led to considerable rivalry in the production and possession of beautiful snuff-boxes. Another product of the early silversmiths much in evidence was elaborate boxes in which were inclosed the parchments conferring the freedom of the city upon distinguished guests. These boxes or receptacles were usually made of silver with a lining of gold, and frequently of gold studded with precious stones. After Andrew Hamilton defended the liberty of the press in New York in 1734 the corporation bestowed their citizenship upon him, inclosing the parchment conferring this in a very elaborate box; and later others were presented to Lafayette, Washington, and Scott. The making of ornamental insignia conferred upon distinguished men developed into an important feature of the goldsmith's work, and the craft received so many accessions to its ranks that in 1788, when the adoption of the Federal Constitution was celebrated in Philadelphia, thirty-five goldsmiths and jewelers turned out in the procession.

More than twenty years before this, previous to the Declaration of Independence, the profusion of silverware, jewelry, and other evidences of wealth in a prominent New York residence, it is said, incited Townshend to introduce the historic bill known as the Stamp Act, the entering wedge by which the colonies were finally separated from the mother country. The viands and the silver in the Walton house were so rich and in so great abundance that English officers who dined there declared that they could see no reason why a country whose inhabitants could afford to live so extravagantly should not be taxed. This fell on Townshend's willing ears, and as a result the British House of Commons began to attempt the collection of revenue from the colonies. Those of them which had the richest inhabitants, and as a consequence those who spent most in personal adornment, were South Carolina, Virginia, Maryland, Pennsylvania, New York, and

Massachusetts. Connecticut, although populous, had few citizens distinguished above the rest for means.

There are no returns in the earlier censuses giving the quantity of production or the places where the various arts which are loosely grouped under the head of jewelers and gold and silver smiths were carried on. Providence, Newark, Philadelphia, New York, and Attleboro have long been, and still are, noted centers of the trade. The tools used in the earlier days were much like those used by workers in other metals at that time, except that they were smaller and better finished for finer work. The extreme tenuity and the lack of brittleness of gold and silver gave play to great ingenuity in varying ordinary patterns with fanciful designs, and the attaining of a polished or burnished surface made necessary a more tender treatment. In the earlier years of the century the frosting of gold and the satin finishing of silver were unknown arts, everything coming from the workshop with a glittering surface, most of the ornamental or decorative work being either crude enameling, applied work, or engraving.

Later the precious metals were also used conjointly with other metals, wood, mother-of-pearl, glass, porcelain, pearls, and gems; but most of these attempts were ambitious efforts to realize the ideals formed from studying, in books and single engravings that from time to time found their way to this country, the illustrations of metal-work. However, nearly every one who engaged in the business at that time learned it thoroughly, in the old-fashioned way that embodied all branches of the trade. A good workman could chisel out a ring or repair a clock, could fix your spectacles, put a new spout on your coffee-pot, or "doctor" your watch. Whatever was to be done mattered little to him, for he was equally competent in every branch; and good honest work was invariably the rule, resulting in articles not equaling in delicacy of workmanship those of the present time, but substantially made and suited to the requirements of the day. A hundred years ago it was impossible to draw a distinction between the occupation of jeweler and either goldsmith or silversmith, or between watchmaker and either clockmaker or maker of fine mathematical instruments—each of these branches involving the others. An artisan, though expert, rarely found sufficient work to employ all his time in any one department of his handiwork, and thus, from no matter of choice, but from compulsion, divided his time and skill between his own and kindred trades.

The seller of these goods then was a workman rather than a dealer, and it was essential for him to have an intimate knowledge of all kinds of metal and fancy work. The more progressive of these artisans developed by degrees into manufacturers, beginning usually with one, two, or three articles in stock, such as spoons, forks, rings, and other small pieces; and later hollow silverware, coffee-urns, teapots, etc.

Providence became early one of the centers of the trade; for the industry secured a footing in that city soon after the Revolution, when the manufacture of silverware was begun by Messrs. Sanders & Pitman and Cyril Dodge. In 1805 four establishments were located there. These belonged to Nehemiah Dodge, Ezekiel Burr, John C. Jenckes, and Pitman & Dorrance. Their products were chiefly silver spoons, gold beads, and finger-rings, and they employed in all about thirty men. Some of them soon branched out into cheap gold jewelry, silver and other alloys being largely used, with a very small fraction of gold, while large articles were plated by the hammering process. Breastpins, earrings, sleeve-buttons, and key-rings, in addition to the articles mentioned, were among the early products at Providence. About the same time work was also begun in Attleboro, which town for many years held preëminence in the trade. In 1812 it was stated that there was then sufficient gold and silver ware manufactured to meet every demand in the United States. In Newark the business of manufacturing goods of this kind began early in the century. The town was favorably situated for manufactures, and the men originally interested in the enterprise, Hinsdale & Taylor, combined industry with enterprise. Philadelphia was always very prominent as a manufacturing town, and a large trade, particularly with the South and West, sprang up there. Bailey & Company were one of the jewelry houses early established in that city, and the firm, under a different name, still exists.

More than sixty years ago Maiden Lane, of New York City, became the great center of the jewelry business in this country, and throughout the world the name of that thoroughfare is inseparably linked with the trade. With the improvements in manufacturing elsewhere, new ideas began to affect the trade. People had grown tired of things which had been always in their possession; they valued the jewels of their ancestors for their associations, but they wanted for their own use something new, something different in design; and this feeling gave an impetus to the trade, New York becoming the natural market for the introduction of every new product.

Among the New York houses that became early prominent in the trade was the firm of Marquand & Gelston, later Marquand & Company. In the New York "Mercantile Register" of 1848–49, in the chapter devoted to manufacturers of silverware, watches, jewelry, etc., we find the advertisements of the following houses, in the order named: Ball, Tompkins & Black (late Marquand & Company), 247 Broadway; Allcock & Allen, 341 Broadway; Gale & Hayden, 116 Fulton Street; Tiffany, Young & Ellis, 271 Broadway; Wood & Hughes, 142 Fulton Street; Samuel W. Benedict, 5 Wall Street; George C. Allen, 51 Wall Street; Squire & Brother, 92 Fulton Street and 182 Bowery; and others. Some of these houses have gone out of existence, one still retains its original firm name, and three are conducted under different firm names, which yet embody some part of the original title.

All branches of art education have been developed to a remarkable degree. In 1830 there were probably not in the entire country as many good paintings as the Metropolitan Museum of Art, in Central Park, contains to-day; and the same holds true, in other departments of art, of fine bronzes and marbles, of ceramics, pottery, and glass; indeed, cultivated taste and artistic discrimination find nowhere better expression than in the selection of choice bits of ceramics, porcelain, and bric-à-brac. If, as a nation, we have made, during the past fifty years, exceptional progress in mechanical improvements and inventions that enter into the practical part of life, our artistic faculties have in no sense been neglected; and although all have not become connoisseurs, appreciation of the artistic and the ornate in form and color is a feeling that knows no social or territorial distinction, existing in the largest cities and the smallest hamlets. It finds expression in the beautiful landscape-work of our parks and the architecture of our buildings; in the wares offered in our shops, and in the manner of their display; in the binding and the press-work of our books; in the illustration of our periodicals and other publications; and in divers other directions; but in nothing is it more pronounced than in the art metal-work of the gold and silver smiths, which has long since placed American products at the head of the art metal-work of the world.

With our increased spending capacity, our greater appreciation of the artistic, and our wider knowledge of articles into whose manufacture good taste enters as an important factor, it is not surprising that, relatively to the population, far more jewelry and silverware are demanded than formerly. The designers now employed by gold and silver smiths are men of liberal education, who can, if required, draw and model from life, and paint in oil or water-colors. They have been specially instructed as artists, and in many instances their training in the art schools and the designing-rooms of the workshops here is not restricted to the study of art from books and engravings, but is supplemented by visits to the galleries and museums of Europe; and in their work on jewelry and silverware, although guided by the universal principles of their art, success depends largely upon the individuality of their work and upon their ability to unite utility of form with appropriateness of color and decoration.

Much work in ornamental gold and silver ware has been done in this country within the past forty years, notably in the way of loving-cups, vases, metallic designs, and presentation pieces. As conspicuous among these may be mentioned the gold medals, valued at $1000 and $500, presented by the State of New York in 1858 to Dr. E. K. Kane and Commander H. S. Hartstein, the Arctic explorers; and the silver vase made in honor of William Cullen Bryant, now in the Metropolitan Museum of Art. The testimonials presented to Cyrus Field upon the completion of the Atlantic cable in 1866 include a gold medal struck for the occasion, a gold box, and many pieces of silverware. Other notable specimens are the silver services presented to the arbitrators of the *Alabama* claims in 1873; the silver centerpiece, "Liberty Enlightening the World," presented to August Bartholdi in 1886; the testimonial presented to William Ewart Gladstone in 1887; the loving-cup to Edwin Booth; and a great number of yachting trophies for international and other regattas. Many of these trophies annually made are of exceptional merit, and examples of art metal-work that cannot be duplicated or equaled in any other country.

The discovery of gold in California in 1848 and 1849 gave us a home supply of this metal, and gave employment to metallurgists and miners. The opening of the expositions in London and Paris revealed to us the forms of art and the increasing business of the manufacturing jewelers in this country, and made comparatively easy the acquirement of inventions in machinery and tools necessary to reduce the cost of products. Great improvements have been made in machinery. At present many articles are prepared by the aid of electro-metallurgy. Since 1860 all kinds of goods for which plating is employed have been largely made in this way, the center of production being chiefly in Connecticut, there being

also large plants at Newark, N. J., and Providence, R. I. This process is highly valuable, because it places within the reach of people of limited means attractive tableware and other articles of utility now deemed indispensable, which, if not as artistic and as highly finished as solid silverware, are serviceable, and in many instances possess exceptional merit.

The production of silver-plated ware, although a great industry, has not retarded or encroached upon the demand for solid silver; in fact, many instances of recent date would indicate that, with the present low valuation of silver bullion and the mechanical improvements that have further reduced the cost of production, solid silver is rapidly increasing in popular favor and making serious inroads upon the sale of all small articles still manufactured in plated ware.

The production of watches is another American industry closely related to the jewelry trade. They are manufactured in a number of States, notably Massachusetts, Illinois, and New Jersey, the making of the watch-cases forming a separate industry, which thrives especially in Brooklyn and Philadelphia. The highest grades of watches, such as complicated chronographs, calendar and stop watches, and very small watches for ladies, are still imported from Switzerland.

Until about 1850 precious gems and articles of virtu of high order were seldom sold in the United States. Wealthy families bought such things abroad, and these sometimes, owing to reverses or other causes, found their way, in the course of time, to the jewelry shops; but the great variety of beautiful and artistic products that can now be purchased at many establishments could not be found on sale in this country fifty years ago. New York or Philadelphia jewelers acted merely as agents to obtain for patrons some desired articles from a European house. But this state of things no longer exists. The objects of art and other accessories of a modern jeweler's stock represent many thousands of dollars, and include opera-glasses, Sèvres ware, fine pottery, ceramics, enamels, glass, objects in rock-crystal, clocks, bronzes, marbles, plaques, antiquities, curios, and many costly pieces of bric-à-brac and cabinet ornaments that appeal chiefly to collectors and connoisseurs of art.

In diamonds and precious stones, that most costly and important department of a jeweler's stock, America is in the front rank of nations, not as producer, but as consumer. It is now conceded that New York is the largest market for gems and precious stones in the world, and that more precious stones are annually consumed—or purchased, in other words—in America than in any other country.

The art of diamond cutting and polishing, although established here for a number of years, recently, through the changes made in the tariff regulations, received such an impetus as to attract many diamond cutters from Holland to this country; and if further revisions are made in the tariff, admitting diamonds in the rough free of duty, it is not unlikely that the industry, which for generations has centered in Amsterdam and Rotterdam, will be centered before many years in New York, Brooklyn, and other cities of the United States.

In the matter of statistics the earliest figures that we have as to the production of jewelry are that in 1812 $100,000 worth was produced in Providence. But as late as 1860 the returns were small. The jewelers and watchmakers of Philadelphia produced in that year $691,430 worth; the silverware men, $516,000; makers of gold watch-cases and chains, $1,714,800. In New York the production was: of gold chains and jewelry, $2,497,761; gold watch-cases, $337,690; silverware, $1,250,695. Newark made $1,341,000 worth of jewelry; Providence, $2,251,382 of jewelry, and $490,000 in silverware.

No summary has yet been made at Washington of the general results of the census of 1890 in manufacturing, but the products of particular towns are given, from which it is learned that the production of jewelry in the previous year in Providence was $7,801,003; New York, $5,605,634; Newark, $4,631,500; Philadelphia, $3,139,596; San Francisco, $1,512,571; Brooklyn, $1,323,234; Cincinnati, $1,317,000; Chicago, $873,000; and Boston, $661,300. The production of silverware was: Providence, $2,509,869; New York, $1,322,235; and Philadelphia, $272,997. Philadelphia leads in watch-cases, with $1,914,222, followed by Brooklyn, with $1,553,993; Newark, with $1,004,584; and New York, with $628,660. Taking the total production in all these articles by cities, Providence comes first, and then, in order, are New York, Newark, Philadelphia, Brooklyn, San Francisco, Cincinnati, Boston, and Chicago. The bulk of the gold and silver products of Providence, Newark, and other Eastern manufacturing centers is sold in New York.

These statistics, however, do not indicate what has been accomplished from an artistic standpoint. American jewelry and silverware have steadily advanced in the quality and the character of products as much as the mere quantity. When the industry was in its infancy we looked to London and Paris for our ideas, our designs, and our models.

Charles L. Tiffany.

Paris, the unchallenged arbiter of all fashions, long held supreme sway in things beautiful and artistic, and in nothing more than rich gems and jewelry; and though we still look to Paris and London for our fashion-plates and many artistic creations which we have not yet mastered here, we no longer accept the models and ideas of our French and English cousins in the designing of our jewelry and silverware. We have marked out a path of our own in this country that has led American products to the foremost ranks of the world. Dealers no longer import foreign jewelry and silverware into this country, because American products are fully equal, and in most cases superior, to those of other countries, in both correctness and originality of designs and workmanship. How our gold and silver manufactures are accepted abroad can best be indicated by a review of some of the press comments in connection with the Paris International Expositions of 1878 and 1889. For obvious reasons the firm names which appeared in these extracts are omitted.

The London "Spectator" of September 21, 1878, says: "It is a modern mistake to assume that the production of good silver-work demands neither special training nor high artistic power. It will not suffice to study old models, however excellent, unless fresh inspiration be gathered from nature, assimilated by the trained mind, and wrought out by the skilful hand into forms of fresh and seemly designs. . . . We confess we were surprised to find at the Paris Exposition that a New York firm . . . had beaten the old country and the Old World in domestic silver plate."

A Parisian publication wrote, about the same time: "Of the many awards which the American section of the Universal Exposition has received, there are certainly none that will excite so little jealousy as those bestowed upon the house of . . . It has been generally conceded that nothing in the whole Palace of the Champs de Mars so richly deserved recognition as the remarkable display made by this famous firm of New York jewelers and silversmiths. Hence the jury were as one with the public, and the palm of honor will be borne away to Union Square."

Speaking of the Parisian awards to American gold and silver ware, the "International Review" of February, 1879, wrote: "The taking of the coveted Grand Prize by an American exhibitor, with the additional distinction of the decoration of the Legion of Honor, is the highest possible official recognition of the supremacy of our metallic art-work."

Closely following these honors and generous tributes, an American house received appointments by Royal Letters as Jewelers, Gold and Silver Smiths, to the following courts of Europe:

Her Most Gracious Majesty the Queen of England;
His Royal Highness the Prince of Wales;
Her Royal Highness the Princess of Wales;
His Royal Highness the Duke of Edinburgh;
His Imperial Majesty the Emperor of Russia;
Her Imperial Majesty the Empress of Russia;
His Imperial Highness the Grand Duke Vladimir;
His Royal Highness the Grand Duke Alexis;
His Imperial Highness the Grand Duke Paul;
His Royal Highness the Grand Duke Sergius;
His Imperial Majesty the Emperor of Austria;
His Majesty the King of Prussia;
His Majesty the King of the Belgians;
His Majesty the King of Italy;
His Majesty the King of Denmark;
His Majesty the King of Greece;
His Majesty the King of Spain;
His Majesty the King of Portugal;
His Majesty the King of Roumania;
His Imperial Majesty the Emperor of Brazil;
His Majesty the Khedive of Egypt;
His Imperial Majesty the Shah of Persia; and other distinguished potentates.

The American displays of gold and silver ware at the Paris Exposition of 1889 resulted in a repetition of the earlier triumphs, and evoked, if possible, even greater enthusiasm and more generous press comments. "Le Figaro," of Paris, June 16, 1889, said among other things, in a review of the exhibit of American jewelry: "It has only taken a few years for the master jeweler and goldsmith of New York to acquire this preëminence in this beautiful art, where the nineteenth century rivals the Renaissance. In the future the metals and precious stones are in his hands, as the potter's clay is in the hands of a Falquire and a Dalou. If the committee of 1878 gave him, joined to the gold medal, the supreme reward of the Cross of the Legion of Honor, I ask, what crown can they give in 1889?"

The selection of press comments from eminent publications, chiefly foreign, deemed free from any bias favorable to American products, has been an extremely embarrassing task, as in every instance the writers included in their laudatory remarks the name of an individual or firm identified with the products which excited their favorable comment, which names have been eliminated from the extracts quoted.

In conclusion, what additional progress has been

made, and shown at the World's Columbian Exposition, is of too recent date to present in detail in this article. Much has been written and printed upon the art metal display of the gold and silver smiths, publications at home and abroad for many months dwelling with lavish and minute detail upon the many extraordinary features of the exhibit, which the London "Art Journal" summarizes in an elaborate review, October, 1893, as follows: "Judging by the productions exhibited, one may well be in doubt whether our much-boasted European pre-eminence in these things is to last much longer, and whether, after all, we shall not in the near future be compelled to regard the firms of New York as at least our equals, if not superiors, in the production of high-class gold and silver work."

C. L. Tiffany

CHAPTER XCI

THE GROCERY TRADE

IN all the category of trade there is, perhaps, no one line so distinctively popular in its ministrations as that of the grocery. Other branches of business meet the wants of many and sometimes of the majority of the people, but to none does the universal demand turn as it does toward this one. The grocery stores of the country are the hoppers through which in bountiful supply pours the great grist of life-sustaining products ground out by the mill of national industry. Abundance such as no former time and no other nation on earth have ever known loads the American board. The humblest citizen enjoys and demands as necessities many of those things considered luxuries even by the wealthy a half-century ago.

The advance which has rendered this possible, however, has had another and a more imperative cause than the increased exactions of the public requirement. This cause has been the marvelous growth which has brought a population of 5,000,000 in the course of a century up to nearly 70,000,000. With the facilities and resources of a century ago and the population of to-day New York would be starving inside of forty-eight hours, and famine stalking over the land in another day. Thus it will be seen that our progress has had a most potent moving cause, and that the wonderful development which has placed us in advance of all other nations has come only in response to an equally great necessity.

In the methods by which are obtained and prepared for the market the great food products of which the grocer is the proper distributer many changes have come during the past century. With these changes and their wide-spreading effects the history of the grocery trade is so bound up that it is impossible to separate the one from the other. The perfection of a system of flour-milling which permits an annual production of 80,000,000 barrels at an average profit to the miller of about five cents per barrel has had too great an effect upon the grocer to be ignored. So, too, have the canning and packing industries, each of which worked its own revolution, reacting always upon the grocery trade too powerfully to be passed over in any history of the latter. Transportation, also, with its increased facilities of railroads and fast steamers, has completely formed anew the wholesale and jobbing grocery trade, as the manufacturers' skill and taste, with the resultant neat and conveniently prepared packages, have transformed the retailer's store into a sightly and attractive salesroom. All of these changes, however, have come about in great part during the last thirty years. Prior to that time the grocers were among the most conservative members of the mercantile community, and kept along much as their fathers had before them.

One century ago the grocery business proper of this country was centered in the cities. The general or country store had not yet appeared, the remote and provincial districts being still too thinly populated. In the cities, notably New York, Philadelphia, and Boston, the grocery store, as such, was already in operation. "Flour and provisions" was the favorite announcement of these early grocers, and their shops were more like the wholesale warehouses of to-day than the elegantly finished stores, with their shelves, glass show-cases, and waxy neatness, now familiar to the grocery patron. These early stores dealt mainly in staples handled in bulk —sacks, barrels, boxes, hogsheads, etc.—and transferred in small quantities to the customers' market-baskets. They were scarcely attractive places, for molasses would draw the flies, rice and coffee escape underfoot in harassing quantity from rents in the sacks, while a general odor of vinegar, oil, and soap, indicating the immediate presence of these commodities in quantity, pervaded the atmosphere. West India rum, brandy in pipes, ales, porter, and stout, with Madeira, port, and Bordeaux wines, also lay about the shops in pipes, casks, and barrels, in

quantity to delight the bibulous, and of quality and price to attract them equally. Such was the retail trade of one hundred years ago, which centered then and for years afterward in New York, in and about Coenties Slip and Front Street in that immediate vicinity. Its custom was drawn from the same sources, and its proportionate amount in the general business of the day was about the same as now, its lack of dainties and luxuries being offset by the more simple habits of living prevailing at that time. The prices which ruled were relatively high, and as labor was cheap, skilled tradesmen, carpenters, and smiths getting only a little over three shillings per day, the people were forced to live very frugally. Tobacco was sixpence per pound; pork and butter, each eightpence per pound; cheese, fivepence per pound; potatoes, one shilling per bushel; Indian corn, three shillings twopence per bushel; and coffee, tenpence per pound.

The wholesale trade at this time had scarcely disassociated itself from the general import trade, although it was beginning to show the first signs of a distinctive existence, and during the next twenty-five years reached quite respectable dimensions. At the beginning of the century, however, the great merchants, whose ships were so rapidly seizing the carrying trade of the world, did the general business of importation, and rum, brandies, wines, and liquor, coffee, spices, tea, sugar, and fruits, figured prominently upon their invoices. In addition to these the East India merchant princes were tea importers to a man; and from the time of the Revolution up to the great failure of 1826, when Thompson, of Philadelphia, through questionable practices, and Thomas W. Smith, of New York, through inability to pay the government the duties owed, went under, this trade was in the hands of a very few men. Besides the two already mentioned, Perkins, of Boston, and John Jacob Astor, of New York, were the two largest East India merchants. Other well-known houses operating in the China tea trade were Broome & Platt, who were among the very first to engage in it when Canton became a free port after the Revolution, and later N. L. & G. Griswold and Hoyt & Tom. At that time the annual imports of tea amounted to a little over 3,000,000 pounds; and as it was cheaper in New York than in London, it follows that Americans imported their tea from Canton direct. Bohea tea at that time was worth thirty cents per pound; souchong or black tea, seventy-five cents per pound; and hyson skin or green tea, $1 per pound. The duties here on tea were two or three times as much as the first cost of the article at Canton, and a single ship often had to pay from $200,000 to $300,000 in duties alone. It follows, therefore, that only the largest merchants were engaged in this trade. It was nevertheless immensely profitable once the requisite credit was secured, as the government allowed duties to go over from a year to eighteen months without interest, merely upon the security of a bond deposited. It was this method of doing business that lost the customs several millions of dollars and prostrated the tea trade for some years after the failures of 1826, to which I have before referred. Among the other great tea importers who have been prominent since then are Howland, Aspinwall & Company; A. A. Low & Brother; Talbot, Olyphant & Company; and Wetmore & Company.

Returning again to the grocery trade proper, the opening of the nineteenth century witnessed the advent of the wholesale grocer. He was almost invariably a retailer as well, with the distinction that he carried a larger stock in bulk and catered to the provincial trade, which was then commencing to seek New York as the metropolis. This trade was active only in the spring and autumn, when the country buyers came in. Goods were shipped almost entirely by water, the river and coasting sloop taking them as far as possible, when they would be landed and transferred to carts to continue to their destination. For this trade the wholesalers could only prepare at these particular seasons, and during the rest of the year their market was limited to the local trade. It was the custom of these old-time grocers—among whom were Peter A. Schenck, 66 Front Street; Isaac Clason, 51 Broadway; Samuel Tooke & Company, 74 Coenties Slip; Benjamin Mead, 13 Coenties Slip; Thomas Storm & Son, 9 Coenties Slip; Benjamin Sands; and Voorhees & Scrymson—to club together, and when some large importer received a cargo of coffee, tea, sugar, etc., purchase the whole consignment, which they would then apportion among themselves. Among the importers with whom this early syndicate dealt were Henry A. & John G. Coster, 26 William Street, who dealt in coffee, sugar, rum, and Holland gin; E. Stevens & Sons, 110 South Street, who sold French prunes, Italian fruit, Antigua rum, and wines and brandies; and Bouchard & Thebaud, who dealt in cognacs and wines. The Griswolds also did a heavy West Indian trade, being large exporters of flour, as well as importers of the usual staples. The War of 1812 brought great times to the grocers; but, preceded as it had been first by the Embargo and later by the depredations of privateers, the im-

James E. Nichols.

port trade was caught with the shortest of stock. Prices ran up at an unprecedented rate; speculation was rife, and thousands of dollars were lost in the summer of 1814 through the rumor, brought by a foreign sloop, that peace had been declared. This rumor served to prick the bubble of speculation, and prices again became nearly normal; but as an indication of how far the trade had been carried away by the fever of the time, a few of the prices quoted just prior to the collapse are given: sugar in quantity, forty cents per pound; hyson skin tea, $3 per pound; and molasses, $2 per gallon. Tea at this time or a little later was paying duty of sixty-eight and thirty-four cents per pound for green and black varieties respectively.

The War of 1812, if it did nothing more, made patent to the country at large the increasing importance of New York. The commercial and mercantile interests were rapidly expanding, and owing to its shipping and maritime enterprise it was already becoming the chief port of entry. For this reason, perhaps, its trade being so intimately connected with the leading imports, the grocery business was rapidly centering upon Manhattan Island. The conclusion of the war saw a fresh impetus given to the trade. A venturesome young firm, R. & L. Reed, left the traditional precincts of Coenties Slip and established themselves at 125 Front Street. It was the first grocery house opened above Wall Street, and the course of the Reeds was considered suicidal. They prospered, however, and others followed. Peter G. Hart opened at 196 Front Street, and ten years later, from 1825 to 1830, there were in this neighborhood Reed & Sturges; Lee, Dater & Miller; Jackson & McJimsey; Harper & Sons; Pomeroy & Bull; Wisner & Gale; S. Whitney; Smith, Mills & Company; Isaac Van Cleef; and A. V. Winans. A little further on in the century and we find such names added to our list as Morgan & Earle, 61 Front Street, of whom the senior partner, E. D. Morgan, was at one time governor of this State; Spofford, Tileston & Company, 125 Pearl Street; and Lippincott, Stephens & Company, 52 Front Street. Benjamin Stephens, of this latter house, was the father of Stephens the great explorer. In addition to the importers and wholesale and retail dealers already mentioned in connection with these early days, was the great auction house of M. Hoffman & Sons, 63 Wall Street. This firm sold all the principal cargoes of wines, fruits, molasses, tea, coffee, etc., that were not captured by the wholesalers at first hand, and was a great power in the American grocery world of that day.

Having thus briefly reviewed the personnel of the trade in its earlier days, it becomes necessary to leave the consideration of this phase of the subject for a space, in order to study the conditions and forces which were already working to bring about the development that the last twenty-five years have seen. Many of the men and houses of whom we take leave in 1835–40 we shall find again when we resume the thread of the narrative in 1870. They were the founders of the American grocery trade of to-day, and in their names and achievements have rendered possible the present enormous emporiums and extended commercial interests.

The germ of the greatest and perhaps the earliest force that aided in the evolution of the grocery trade appeared in 1837, when Thomas B. Smith, of Philadelphia, commenced the canning of corn in that city, after the process brought out thirty years before by the Frenchman Appert. It is claimed that Ezra Daggett and Thomas Kensett, of New York, were the first packers in America, having secured a patent for a canning process in 1825. If they were, they failed to introduce their product to general notice; and, indeed, neither Mr. Smith nor Henry W. Crosby, who first placed canned tomatoes on the market in 1847, had achieved any great success up to 1849, when the rush for the California gold-fields began. This created a brisk demand for canned goods, which continued, but in a more or less desultory way, up to the breaking out of the Civil War. The impetus then received has since kept canned goods in the very forefront of the grocery interests. To-day all manner of meats, fowl, fish, fruits, and vegetables are preserved in this way. There are nearly 2000 canning factories in the United States, or more than in all the rest of the world combined.

A second great influence in the enlargement of the grocery trade, that followed the beginning of canning by some years, was the improvement and cheapening of the methods of sugar refining. Fifty years ago raw sugar was worth about ten cents per pound, and as the refiners wanted 100 per cent. more for handling it, a great quantity of raw sugar was imported for direct consumption. This continued until the time of the war, and a feature of the old-fashioned grocery store was the portable sugar-mill in which the "boy" ground the raw and lumpy muscovado from Cuba into such forms as could be sold. Cut loaf-sugar was first known in this country in 1858, when it was brought out by Havemeyer & Moller, the sugar refiners. The same firm has the credit of having introduced granulated sugar

some ten years earlier. The war tariff first turned the American consumer toward refined sugars, and the later invention of the centrifugal machine, which reduced the time required for refining from two weeks to twenty-four hours, settled the fate of the raw sugars. Under these conditions, the sugar refiners, who formerly got ten cents per pound for handling, are now able to do it for less than one cent per pound, and the old brown sugar of twenty-five years ago is no longer seen on the table of even the poorest working-man.

It was in this formative period, also, which I have placed between 1840 and 1870, that fancy groceries, table delicacies, prepared condiments and sauces, and the hundred and one little tidbits for the gourmet first began to appear upon the retailers' shelves and in the stock of the great wholesale houses. French fancy groceries first appeared in the American market in 1858, imported by G. G. Yvelin, later Yvelin & Smith, and A. Godillot. The domestic manufacture and trade in these fancy lines antedates the importation of them from France or elsewhere by nearly ten years, and the firm of E. C. Hazard, then located in Barclay Street, is credited with being the pioneer.

Among the canned products, corn, tomatoes, fruits, and corned beef were the earlier goods in the markets. Lobsters were first put up in 1848 at Harpswell, Me., and the salmon from the rivers of that same State was in the market, canned and delicious, as early as 1841, or just twenty-five years before his Western cousin from the Columbia River was introduced to the public. Of the progress this one branch has made since it started it is only necessary to say that from an output of 4000 cases the first year the annual production is now, in round numbers, 1,750,000.

The curing of meats, hams, and flitches of bacon makes another chapter in the story of American progress in the lines under review. The marked improvement seen in this direction to-day is scarcely to be attributed even in its inception to the early period in which we find the other causes moving, but it has proceeded so directly from them that it may most properly be considered here. It accomplishes in a day and a half what formerly took nearly a month and a half. In addition to the economy in time, these improved methods have also resulted in a superior product.

Summarizing thus the influences which for three decades were quietly but steadily tending toward advancement, we come to the year 1870, which may be said to have marked the advent of modernity into the grocery trade and its methods. The retail store was still distinguished by many of the characteristics familiar to the early traders of Coenties Slip. Staples in bulk, doled out in brown-paper parcels to customers, were still the rule; the "shelf goods" of to-day were almost unknown. Fruits in barrels and casks, sugar in boxes, and molasses in hogsheads still stood in unsightly cumbersomeness in the middle of the floor. The sun-cured fruits of California were unknown, the vast resources of that State in this direction being still undeveloped. Evaporated stock, too, was still of the future. The stores were small dingy places compared with the great establishments of to-day; the old sugar-mill, the back-breaking "fall," and stuffy little offices, in place of light and airy counting-rooms, were prominent features. Despite all this the spirit of progress had entered, and innovation in one form or another was an almost daily event.

Of the famous firms of that day, including importers, only a few need be mentioned in tracing the trade descent. Among these were the O'Donohues; E. & R. Mead, Jr., & Company; E. D. Morgan & Company; Carter, Hawley & Company; H. K. Thurber & Company; Fitts & Austin; Rufus Story & Company; Philip Dater & Company; Arnold, Sturges & Company; E. C. Hazard; F. H. Leggett & Company; Rufus Park & Company; Stanton, Sheldon & Company; Bonnett, Schenck & Company; Hoppock & Greenwood; Pool, Nazro, Kimball & Company; Apgar & Company; Henry Welsh; Woodruff, Spencer & Stout; Williams & Potter; S. Burkhalter's Sons; J. & H. Van Nostrand; Penfold, Charfield & Company; Reeves, Osborn & Company; and many others.

The business done by these houses was scarcely of a magnitude that would have placed them in the front ranks to-day. An annual trade of $1,500,000 was rare, and large houses were looked upon as having a very comfortable sales account when it ran above $750,000 per annum. The trade of the country was at that time in its infancy. Buyers still kept up the old-time custom of coming in to purchase stock but twice a year. The railroad systems that have since bound us to every little town and hamlet were then but in their commencement, comparatively speaking. The price-list of the great wholesale house, quoting everything from a barrel of molasses to a ten-cent bottle of flavoring extract, was unknown to the rural shopkeeper, as was its accompanying advantage of being able to drop a postal-card order in the evening and receive the goods by first freight. The delivery systems of the

large houses were but meager in their facilities as compared with those by which thousands of dollars and tons of stock are to-day passed smoothly and swiftly through the shipping departments of the great New York establishments.

Fancy groceries were still regarded as a specialty, and the few houses which carried them to any extent considered themselves outside of that general wholesale trade which dealt mainly in the regular staples, such as tea, coffee, sugar, rice, molasses, starch, flour, spices, oil, soap, etc. Raisins, grapes, and olive-oils and fruits from the Mediterranean, in casks and boxes, were also stocked, but to a great degree the liquor department of the business had become a separate trade. A few of the large houses still carried wines, liquors, and cigars, but the proportionate amount of sales for that account, as compared with the total volume of business, was and is much diminished.

The West Side houses have always had the larger and more assorted stocks, and many lines of luxuries and proprietary goods appeared in their inventories nearly twenty-five years ago, although the distinctively fancy lines, including canned specialties, were in the hands of a few dealers. Gradually the increasing demand caused an expansion of stocks and business that drove many of the large firms from their old quarters; and no buildings in that section of town being commodious enough for their rapidly growing needs, the great grocery warehouse, erected and designed solely for that purpose, began to appear. The West Side trade centered naturally around Chambers Street, where it was in easy reach of the ferries and great railroads, gradually moving slightly north; and this section has since remained grocers' territory. Here to-day within a radius of a few blocks are no less than six large establishments, and two whose annual business aggregates about $25,000,000. Within their great warehouses centers the grocery trade of New York. Huge retail establishments uptown and around town, importers over on the East Side and in the lower part of town, all do an enormous trade, but they lack the distributive scope of the West Side warehouses. Not only as distributers, but as importers and manufacturers as well, do these establishments figure. Direct to their depots the products of the whole world are brought. Freights, the bugbear of the grocery merchant, either wholesale or retail, a quarter of a century ago, have been reduced to a degree directly appreciable to the consumer in the prices he pays to-day. Grain and beef are now transported from Chicago to New York for one third and one half respectively of the rates charged in 1870; canned goods and fruits from California come through for less than one quarter of the old-time rate. Ocean freights, too, have fallen, and this is likewise apparent in the prices of many imported articles.

Improvement and invention have everywhere worked changes in methods and processes that have aided equally in lowering prices to the consumer. The great abattoirs of Chicago, where thousands of cattle can be slaughtered in a day and not one scrap of the carcass from the hoof to the horn be lost, make, it is claimed, so small a profit as $1 per head a most remunerative business, simply through the magnitude of the totals. The old-time butcher would have starved to death had he had no wider margin of profit than this. At the same time the price of both the dressed and the preserved or canned meats has fallen far below that formerly charged. In the matter of canned meats especially, as being most closely connected with the grocery interests, the prices in forty years or a little more have dropped fully sixty per cent. So in all the other lines a cheapening of the necessaries of life has resulted, in which the national progress may easily be measured. Flour, better than any ever known since the first miller dusted his white cap, is now in the market at a price that, after deducting handling, transportation, and manufacture, leaves a per-barrel profit so small that only the figures which show that the United States annually consumes about 65,000,000 barrels and exports over 15,000,000 more could make its small cost to the consumer possible. A barrel of flour in 1870 was worth $6.75, that to-day is quoted at less than one half that price. Sugar, which in 1870 cost nearly fourteen cents a pound when granulated, has fallen to between four and five cents. Here again with the narrowed margin of profit is found the vastly increased consumption, the figures having more than doubled, and sixty-four pounds in round numbers being placed to the credit of each inhabitant, where thirty-one pounds per capita were consumed in 1870.

Coffee is one of the few staples that have not fallen in price proportionately as they have increased in general use. This has been due to the fact that the supply has never yet been able to outrun the demand. The establishment of coffee exchanges here and in Europe has also had a sustaining effect on prices, as it has made coffee an article of speculation proportionate to other speculative products limited in quantity and easily controlled, so that capital and skilful manipulation have often sustained prices on a weak market. The effect of the exchange is to

concentrate the coffee trade largely in New York, and to-day this market to a considerable degree makes the markets of the world. The United States consumes annually in the neighborhood of 300,000 tons of coffee, and with the exception of the period of three or four years around 1885, when the price for fair grades of green Rio declined as low as nine cents per pound, the price has been uniformly maintained, the greatest variations noticed in nearly thirty years, apart from this brief period, being only a trifle over four cents per pound. Butter, cheese, rice, canned goods, molasses,—nearly everything, in fact, that could be specified,—has meanwhile shrunk in price, and, with but a few exceptions, increased in amount consumed. The exceptions in nearly every case are to be noted where the article in question has been superseded by an improved product. Wines, liquors, and cigars, perhaps, ought to be named as the only lines which fall outside the application of this rule. The increase in the sale of fine brands of these three specialties has been in no way proportionate to the advance noted along other lines; yet it has been sufficiently great to exhaust the choicer qualities of the supply, and hence prices have not diminished.

One other article in the grocery trade of which mention has to be made is tea. It follows along under the general rule of increased quantity and lessened price. From China this country has turned largely to Japan teas, as well as to a few from India. Where nearly all the tea consumed here prior to 1857 came from China, the total imports now show about one half to the credit of that country, with Japan a close second. The increase of the total trade is shown from the fact that one hundred years ago the entire imports were only about 3,000,000 to 4,000,000 pounds, where to-day they are between 90,000,000 and 100,000,000 pounds. Keeping step with this advance, the price has fallen from fifty per cent. to sixty per cent. in most of the grades.

The significance which lies in the foregoing figures is the epitomized story of the grocery trade. It tells more eloquently even than can the immense emporiums where the business has its homes to-day of what the wants of a great people can do in the development of their resources. Huge establishments, frequently having their own manufacturing plants in various lines, furnish price-lists of thousands of articles; and yet with all their mammoth undertakings and endless facilities they are simply filling the field that the grocer of one hundred years ago filled quite as completely after his own fashion. Whether or not that fashion was as satisfactory as the present one is quite beside the question. Even had it been, it would still have failed to-day, just as all the crops of that day would have failed to feed the world of our time, through sheer inadequacy. Millions of capital invested stand to-day where hundreds would have been hard to find a century ago. Transactions have also increased in like proportion. All over the country thousands of stores, neat and commodious, furnish to the poor man what the nabob of a century ago could not have obtained; the larger dealers drawing their supplies from headquarters at New York, the smaller retailers from near-by cities where the stores are larger again and the wholesale dealer appears. These city wholesalers as intermediaries draw on the great central depot of New York, where through the medium of the greatest importing, manufacturing, jobbing, and commission establishments in the world is flowing steadily the current which supplies life with its first and greatest necessity—food. The description of business as conducted in one of these systematically organized great houses thus comes properly to form the final chapter in the history of the American grocery trade.

Beginning with the building itself, the great grocery firms of New York are similar in that they occupy their own homes, some of them covering the greater part of a city block—enormous ten-story buildings, where from basement to top story is stored the most complex stock to be found outside of a department store; lighted by electric lights, reached by fast-running elevators, and filled with every product demanded by the perennial hunger of the human race. On the ground floor is located the shipping department, where from twenty-five to forty great two-horse trucks and delivery wagons can be loaded at once with expedition and accuracy. Another floor is usually given over to the offices and counting-rooms, handsomely finished off, where a force of clerks, the pay of whom alone would have swamped the old-time merchant, is kept busy recording the infinite detail of the firm's transactions. A few houses have their own facilities for roasting coffees, grinding spices, etc., our own house having a modern coffee-roasting plant that is capable of turning out 100,000 pounds a day; also a fireproof spice-grinding room, with high-speed steel mills with a capacity of over 10,000 pounds. Extensive plants for packing various lines of farinaceous goods and olives, and also for compounding and manufacturing extracts, essences, etc., can be found in some of these mammoth wholesale establishments.

In the fancy lines, and in preparations of all sorts, the modern grocery establishment is itself a whole food exposition. With floor-spaces frequently aggregating acres, there is scarcely a square foot not utilized, and thousands of dollars have to be kept locked up in single items of the large stocks required in the business of to-day. Single firms who do an annual business of nearly $5,000,000 are not extraordinary, these figures being frequently exceeded, and in one or more cases nearly trebled. What the aggregate volume of the grocery business of the country is at present it is impossible to say, owing to the great variety of interests connected with it. That it is many hundreds of millions is as certain as it is that in these millions is represented a greater equivalent than ever before in the history of the world. Above all, it is an actual value that they represent, based, as is the grocery trade itself, upon the real worth which attaches to the necessary things of life as contrasted with the long list of its superfluities. With such a foundation, and in the light of the evolution of the last century, there would seem no future too broad and successful for the grocery trade in the United States.

James E. Nichols

CHAPTER XCII

THE FRUIT TRADE

THE fruit trade is among the youngest and most recent of those commercial undertakings which have attained a national importance within a comparatively few years. Based as it is upon the increased prosperity and improved conditions which have rendered the luxury of yesterday the necessity of to-day, it is still further strengthened by the variety of the interests it unites. The grower in distant California finds his welfare inseparably bound up with that of the great eastern commission houses in New York which look to the retail merchant, who in his turn falls back upon the small street-fruiterers who, from upwards of 10,000 stands, are daily supplying the population of the big city with fresh, ripe, and luscious fruit from orchards thousands of miles away. For a penny the poor man has to-day what the dollars of the nabob could not have procured a century ago. The hot-house of fifty years ago, with its limited and practically priceless production, has been superseded, and Nature herself, circumvented by human invention, sees her seasonable gifts to tropic climes whisked in a moment over hundreds of miles to relieve the rigors of northern barrenness. The strawberry that ripened in Florida is scarcely picked before the power of steam is bearing it northward to the winter and the snow-drifts of New York, where it is none the less a strawberry because June is still far away. As it is with this, so with all other fruits, whether quickly perishable or more enduring, their handling is a business where celerity is of the utmost necessity. System and organization, availing themselves of the facilities of the railroad and the steamship, have accomplished wonders; but the fruit trade must always be considered as peculiarly susceptible to market conditions, owing to the fact that a few days, or even a few hours, sometimes suffice to render worthless invoices valued at thousands of dollars. In spite of these risks the fruit trade has increased, and in the face of its most serious difficulties have been evolved some of the most noteworthy of those improvements which have contributed to its development.

One hundred years ago the fruit merchant as such did not exist in this country. Some of the larger importers occasionally received, among the other articles of an assorted Mediterranean cargo, a few half casks of dried prunes, currants, raisins, or grapes, but beyond these even the luxurious did not aspire. It was some years before even so simple a custom as selling native fruit brought to town in season by the neighboring farmer became at all general with the old New York grocers. Having reached this point of development, the fruit trade rested, and it was not until 1830 and later that the importation of foreign fruit was considered seriously. Prior to this, however, in 1804, the first bananas were imported into the United States. Captain John N. Chester, of the little schooner *Reynard*, was the skipper of this original West Indian "fruiter," and thirty bunches were about as many as he thought the American market would stand at one consignment. For twenty-six years after that bananas were only occasionally brought to this country and in but small quantities, until in 1830 John Pearsall, of the firm of J. & T. Pearsall, imported the first cargo. He chartered the schooner *Harriet Smith*, and from her he landed in this city 1500 bunches of bananas — the first large shipment. From that time the banana trade continued in a modest way — a few cargoes annually for a score of years.

The fruit trade meanwhile was not waiting for this branch, but was developing steadily in other directions. In 1832 there arrived at New York by sailing ship the first cargo of oranges from Sicily. Lemons followed almost immediately, and the Mediterranean fruit trade became a recognized interest from that time. The next thirty years saw the Italian fruits, oranges and lemons, holding full possession of the

American market. Sailing ships chartered here and sent across brought back the fruit, much of which was bought from the importers by dealers and speculators before it had been a day at sea, and while its quality and condition were largely matter of guess work. The transatlantic cable not being laid at this time further increased the speculative nature of this trade. From this somewhat hazardous method of buying, and the difficulties it so frequently led to, through the buyer's disappointment with his purchase, arose the auction system of selling fruit. Minturn & Co. were the auctioneers to whom all the early foreign fruit sales in this city were intrusted, and the transactions under the hammer were usually small. Five thousand boxes was a good-sized cargo in those days, and among the many buyers on one invoice those who refused their contracts were so few as to render the auctioneer's services but seldom needed. Little as was the amount thus sold, however, it was not long before some of the shrewd old merchants began to notice that fruit, even when so unsound as to induce a buyer to refuse his contract, was sold in this auction-room readily and at a fair figure. The natural deduction from this was that, if unsound fruit could be sold to advantage at auction, sound fruit could be sold to still greater advantage. Based upon this reasoning, and having the further advantage of quick returns, the auction-houses came into existence, and have continued ever since as important factors in the fruit trade. This method of disposing of fruit did not come in all at once, however, the great importing houses having intrenched themselves too firmly. Until so late as 1865 these houses controlled the market for foreign fruit in this country, and bought directly from Italy. Among these firms, famous thirty-five years ago, were Devlin & Rose; Chamberlain, Phelps & Co.; James Robinson & Co.; and Lawrence, Giles & Co., of New York; Daniel Draper & Co. and Conant & Co., of Boston; Dix & Wilkins, of Baltimore; and S. S. Scattergood & Co. and Isaac Jeanes & Co., of Philadelphia. In this latter year the wholesale commission house having come to be a generally recognized feature of the fruit trade, many of the Italian growers began consigning their fruit directly to American firms. This arrangement, dispensing with the Italian middleman, was found the more profitable for both the grower and the American jobber, and for fifteen years the Mediterranean trade continued on these lines. About 1880, the third and last change in the methods governing the Italian fruit trade began with the establishment here of representatives by several of the large Italian houses. Since then they have increased, and now practically control the Sicilian and mainland output, the foreign shipper naturally preferring to deal with a compatriot rather than with strangers. Spain, once a large shipper of oranges, has been forced from the American market by the Italian growers, and excepting her grapes, of Almeria and Malaga, and latterly her lemons, she sends little now to this country.

The foreign fruit trade of the United States, briefly summarized in the foregoing, has undergone great changes in the last quarter of a century. This period has been the one within which interests amounting to thousands of dollars have been multiplied to millions, and quantities expanded from cart-loads to car-loads. Up to 1867, the foreign fruit grower and shipper saw no cloud on the horizon of the American market. The lemon of Sicily and the sweet Messina orange competed only with the apple for Yankee favor. Grapes, raisins, currants, prunes, every European fruit — green, dried, or preserved — found in the United States a market that was never glutted except by itself. Bananas and pineapples from the West Indies, Cuba, and Central America, cocoanuts and tropical fruits of every description, came, but in limited quantities, and an auction house that could do a business of a million a year would have been considered an impossibility. Nevertheless it has come, and the causes which have led to this marvelous advance are to be found wholly in the development of American resources. Prior to the Civil War and for several years afterward the small fruits of New York, New Jersey, Long Island, and Delaware were the only competitors of the foreign fruit. Occasionally a sloop loaded with watermelons would roll up from one of the Southern ports, or a few crates of the same fruit came by rail, but there was no systematized trade as there is to-day. Peaches were to be had in season, but if the much-bewailed Delaware crop really did fail, the market and prices both appreciated it, and California was not just behind waiting to come to the rescue as she is to-day.

Such was the condition of affairs in 1867, when the first consignment of green fruit from California was shipped by express to New York. It was an experiment, and neither in the condition in which the fruit arrived, nor in the expense involved in its transportation, can it be said to have been a success. Despite this fact, however, the idea having been thus exploited, there were others ready to make trial of it, and in November of the following year one car of grapes and three cars of pears were received in this

city, having come through from California consigned to N. R. Doe. The pears were in good condition, and brought from $3 50 to $5.00 per box, while the grapes, principally Tokays, brought from $10 to $15 per forty-pound crate. The transportation charges on the grapes were $1200, and the ventilated car containing them came through attached to a passenger train. Contrasting the prices brought by this early consignment with those of to-day, it seems scarcely possible that so short a time can have worked so great changes. The California overland fruit trade has been one that has grown steadily since its commencement. It has built up the wonderful garden State itself, profits ranging from $500 to $1000 an acre having frequently rewarded the growers; it has swelled the receipts of the transportation companies by hundreds of thousands of dollars; rendered this country independent of external sources of fruit supply; established great agencies in the Central and Eastern cities, and is even now reaching out across the Atlantic to an English market on the other side of the world. Thousands of car-loads of fruit are shipped every year, of which from 1000 to 1500 come to New York. California has been wise enough, furthermore, to see that her best interests are conserved by direct dealings, and the attempt of Chicago a decade ago to intercept all through fruit trade from the West and distribute it, with herself as the center, failed completely.

For the transportation of the California fruit product, private enterprise has provided refrigerator cars, of which there are now several lines. The California Fruit Transportation line was the first to start, and by carefully looking after its interests this line has been largely instrumental in making the cross-continent fruit trade a success. In these cars the fruit is packed and refrigerated in California, and taken out later in New York in practically the same condition as when it left. The great drawback to the California trade at present is the freight rate, which for so long a journey is necessarily far too high to allow the realization of proper profits by all connected with the fruit interests. Already a disposition has been shown to remedy this evil, to some degree at least. The through rates from San Francisco to New York have been reduced in some cases as much as fifty per cent. in the last twenty-five years, and the facilities accorded by the railroads in the matter of speed, and by private enterprise in the way of rolling-stock, have been improved to an equal extent.

In addition to the golden peaches and pears and full clustered Tokay and other grapes so well known on the fruit-stands and peddlers' carts as the product of California, this State also produces a large crop of oranges and perhaps the largest of apricots, and it will also in the near future give us a full supply of lemons superior to and more plentiful than the Sicilian product. In the matter of oranges California is a new comer, not 5000 boxes of fruit, from that State, having been sold in New York up to two years ago, although the Western markets knew them earlier. The California orange groves developed more rapidly than those of Florida, and for this reason their product is already assuming a larger importance than that of the latter State, which has, however, grown them much longer. The commencement in the Florida fruit trade was made early in the seventies, just after California with her pears, peaches, and grapes had so successfully crossed the continent. Oranges were then, as now, the strong advantage of Florida, and with them she first presented herself to the Northern market. Their quality speedily secured their popularity, and in the few years between 1875 and 1880 the foreign dealers began to realize that the American fruit growers of the Gulf Peninsula were seriously in competition with them. While the direct consumption of foreign fruits, notably oranges and lemons, has increased very considerably since that time, it has been due to the growth of the country and the consequently greater demand, and prices have declined materially, the consumer reaping the advantage. Between the foreign and the home dealer in fruits the advantage in freights has, singularly enough, always rested with the former. The Sicilian shipper can box, transport, pay customs duties in New York, and still land his oranges in Washington street, New York, at a less expense than can the Florida grower. Excessive rail rates for local freights, together with the almost inevitable transshipment at Jacksonville, make a great part of the Floridian's expense. Compared to the freight charges from Florida those from California are considerably lower proportionately, although in their gross amounts they exceed the former. In both cases the Italian product is cheaper to its market by from 30 to 60 per cent., exclusive of the original cost and whatever difference the cheaper labor of Italy might make in that item. Nevertheless the native fruit holds its own and more. Excluding the abnormal conditions of last year, when the fruit interests of Florida received such a disastrous blow from the freezing weather, there would have been no reason why the orange crop of that State and California to-day should not have approximated

John W. Nix.

8,000,000 boxes at the least. Three years ago, Florida shipped 900,000 boxes of oranges to New York, and this amount was estimated to be only about one quarter of the total crop, which would therefore have been 3,600,000 boxes. California in the same year was producing 2,500,000, which gave as the total for the American crop, not including the Louisiana and Arizona yield, 6,100,000 boxes. The groves were at that particular age where each of the next few succeeding years produced a great increase in the bearing, and had it not been for the unprecedentedly severe weather of last winter, a crop of even so much as 12,000,000 boxes might have been produced. All this has, of course, been altered by the blizzard of December, 1894. Where Italy was sending but 1,000,000 boxes of oranges to 900,000 from Florida in 1893, the present year will see her figures many times greater proportionately; and in the other lines as well, notably lemons, the prices will show that the foreign growers and shippers are again controlling the American market as they have not done before in twenty years. With the exception of these staple fruits, however, Florida is still a purveyor to the northern markets to the extent of about 10,000,000 pineapples annually, while $250,000 worth of limes are grown each season. Around the fruit raising industry in its great strongholds has grown up, in the packing for shipment, a branch which now employs many hands, and which in the supplying of its boxes and wrapping papers has created a most lucrative trade. An expense of thirty-five cents for boxing, nailing, wrapping, packing, and cartage is not excessive for each box of oranges or lemons shipped, and when the shipments run into the millions of boxes, the importance of this one item can be easily appreciated.

Before coming to the fuller discussion of the magnitude and condition of the fruit trade to-day, especially as it centres around the great market of New York, there is one other phase of the general American situation that must be mentioned. This is the export trade, consisting largely of dealings in American apples. A half century ago America sent only a few thousand dollars' worth of dried apples abroad. The sun-drying of California and the evaporated stock of to-day were unknown. In 1850 the exportations of American fruit amounted to only $24,974. Its increase since then is shown in the following table:

FRUIT EXPORTS.

Year.....	1850.	1860.	1870.	1880.	1894.
Value....	$24,974	$206,055	$542,502	$2,090,634	$2,299,006

England is the great receiver of our exported product, and a million barrels of apples can be absorbed by the capacious auction houses of Liverpool, London, and Glasgow during a season. Of the recent experiments to make the Briton a buyer of our finer fruits from California, it is still too early to speak. The insular prejudice which induces the English buyer to demand that fruit brought from California shall be guaranteed to keep sound a week, while he buys fruit from across the channel without any guarantee, is simply in the nature of those encountered at the outset by every American product that has attempted the markets of the United Kingdom. Eventually there can be little doubt that California fruit will find a ready and profitable market on the other side of the Atlantic.

In the meantime, while this advance is still largely in the future, it is most satisfactory to consider the present condition of the fruit trade as contrasted with its status fifty years ago. The last year for which the statistics are complete, that of 1894, shows the total importations of fruit into this country to have been $17,353,559. In the transportation of this great bulk of so fragile and perishable a nature there is now engaged a special marine which has been built for this especial service. The raking and piratical-looking little schooner built for lightness and speed that plied to the West Indies and Central America ten years ago has now been largely superseded by the specially constructed fruit steamer, a fleet of which vessels, numbering more than a hundred, plies between New York and the foreign fruit-shipping ports. These steamers, between the steel outer hull and the inner one of wood, are packed, as is the household refrigerator, with charcoal, a non-conductor of heat. Separated deck planks, insuring to the cargo below a free circulation of air, are also a feature of these ships, which are otherwise equipped in all respects as first-class carriers, with triple expansion engines capable of great and sustained speed, steam steering gear and applied power.

It is in this fleet that the greater part of the $10,000,000 worth of fruit comes which is taken by New York as her share of the total annual importations. Once arrived here, it is handled in any one of the variety of ways that its shippers may have chosen from the methods now in operation among metropolitan fruit-traders, either through the auction room, the wholesale commission merchants, jobbers, brokers, or representative buyers. All these offer avenues along which can be discharged the newly-arrived cargo within twelve hours after passing quarantine. Their particular functions are too apparent to require description. In the further distribution of the fruit, the

retail local merchant, the out-of-town dealer, and the regular demand for consumption are important factors. Upon the latter of these depend the two former to a great extent, and this in its turn is dependent upon the weather to a degree little understood. Cold, rainy weather, raw and unpleasant, will invariably depress in a marked degree the price of the more perishable fruits; while, on the other hand, a hot spell, creating a double demand, drains the market and puts prices up as if by magic. Behind the weather, however, we see in this the ultimate responsibility falling upon the character of the stock. Its perishable nature and the many opportunities that irresponsible dealings in consequence offer for fraud, have led the trade of New York, and every other great center as well, to establish certain safeguards and seek in organization to combine the better elements against questionable methods. Among the larger and better known of these organizations are the New York Fruit Exchange, operating on the same principle as the other great exchanges; the Fruit Buyers' Union, which aims to regulate the methods of the green-fruit import and auction business so as to render corrupt practices impossible; the National League of Commission Merchants, the aim of which is to secure uniformity and integrity of method and purpose in the commission business; and such organizations as the great Florida and California Fruit Exchanges, which are designed to support the same ends, for equally potent if somewhat different reasons. Through the medium of these organizations — the other large cities, such as Boston, Baltimore, Philadelphia, Chicago, and New Orleans, having similar ones — is transacted the greater part of that business, which, as already shown, aggregates in its exports and imports very nearly $20,000,000 annually. In addition to this must be reckoned the domestic product, which, while variable, and not reducible to exact statistics as is the customs-classified foreign product, still amounts to at least an equally great sum. A total verging toward $50,000,000 is not excessive to give in representing the annual interests of the fruit trade. The invested capital, either in the growing or in the more mercantile branches of the industry, cannot be estimated. There is no possible standard from which to figure, but the investment is certainly very great and far in excess of what the annual movement might be considered to indicate. A last illustration of the magnitude of the fruit business can be gathered from the fact that fruits considered in the unit have small value, and yet figured from pennies the dollars run into the millions. There are from 13,000,000 to 15,000,000 bunches of bananas imported annually, and last year the sum of $4,285,278 was needed to pay for the lemons imported. Even supposing that so few as twenty-five lemons could be purchased for a dollar, the total number of lemons thus consumed would amount to well over 100,000,000, exclusive of the domestic product. Other values, which will give some idea of the itemized magnitude of the fruit-trade in 1894, are oranges imported, $1,127,005; bananas, $5,122,503; raisins, $554,087; cocoanuts, $786,777; currants, $774,802; plums and prunes, $416,342; and dates and figs, $779,626. For pears, peaches, grapes, apricots, and all the infinite variety of domestic fruits, the figures are even greater. The last crop of Florida oranges was estimated at 6,000,000 boxes, and from California this year 2,500,000 boxes of the same fruit are expected. The apple crop for this season is estimated at upwards of 60,000,000 barrels — a great trade of itself. Around the handling of these large quantities of home fruits has grown up an interest affording employment to an immense force of laborers. The cultivation of the orchards, the gathering of the fruit, the packing, shipping, and handling on the market; all these branches furnish work for thousands of people, and give the fruit trade an economic as well as a commercial importance.

Sufficient has been given to show how vast an interest has grown up around this youthful enterprise. With the progress of the past to encourage, and the conditions of the present to assist, there seems no reason why the next quarter century should not witness a steady advance in the business.

John W. Nix

CHAPTER XCIII

THE DRUG TRADE

VERY different was the drug-store of old from the modern counting-room and clean warehouse, and very different the business methods pursued. The development of the drug trade during the last century has kept pace with the wonderful progress achieved in all lines in this period of advancement and discovery. Pharmaceuticals and chemicals, in this short span of years, have been raised to foremost places in the list of the world's productions, and the United States to-day is able to furnish the world with anything it needs in medicinal wares, having in many instances displaced home products in foreign countries which are now buying our goods.

In order to obtain a comprehensive idea of this wonderful evolution and development it must be borne in mind that the apothecary of old went through a form of apprenticeship, the initiatory steps of which were making the fire, sweeping out, and washing mortars and bottles. Then, after going through various graduations, he was trusted to make up prescriptions, no examination into his qualifications being ever made. Occasionally one with ambition, by study and experiment, would make some discovery in medicine or science.

Formerly a large part of the wholesale druggist's stock consisted of glassware, oils, paints, putty, indigo, and madder, and in dull seasons the apprentices and clerks were kept employed at putting up essences, paregoric, castor-oil, and the like in small vials for the retail trade. Dealers in England and in the Old World generally were then, as to-day, on the lookout for new remedies; so when trade was opened with America all "yarbs" and roots from here were examined for medicinal virtues, and it would seem as if the catalogue of the New World's products is not yet complete, for only very recently cascara sagrada, yerba santa, and damiana have been found valuable. Doubtless many of the old remedies were favorites with the Indian medicine-man, and some are still known by their Indian names. One of the chief advantages which the world derived from the discovery of America was, according to the learned men of that day, the introduction of new and powerful drugs. For a long time, tobacco, sassafras, and Jesuits' bark were commonly used medicaments. The vegetable and animal kingdoms being very different here from those of Europe, it is not surprising that physicians, as well as the unlearned, fancied that among so many new drugs some must be very valuable. All the old chroniclers dwelt much upon the health-giving qualities of American herbs. Everything that grew here was tried. But it would not be fair to put upon the shoulders of our cousins across the ocean the whole burden of this almost superstitious belief in the curative properties of American plants; we must bear a little of it ourselves. Great faith is still placed, in some sections of our country, in the various snake-roots, once popularly believed to be specific for snake-bite.

Throughout the whole history of medicine and pharmacy may be found the misnamed "patent," properly the secret, medicine. The earliest manufacturing druggists were those who made these secret remedies, which are not the outgrowth of the present century, but have been made for hundreds of years. The public used to believe in them even more blindly than to-day; powers were claimed for them far beyond what are claimed for any that are now sold,—extraordinary as this may seem,—and stopped at one limit only, namely, they were not guaranteed to raise the dead. By their use everything else could be accomplished, from the knitting together of a broken arm to the receiving of sight by one born blind. These pretensions had diminished by the beginning of this century, but there was still more natural faith in the community than now,

of which the makers of patent medicines availed themselves, and their preparations formed an important item in drug stocks.

Prominent makers of patent medicines in this city fifty years ago were A. B. & D. Sands, Dr. S. P. Townsend, Dr. Jacob Townsend, Dr. Moffat, and Dr. Brandreth. The names of two Drs. Townsend are given, because the two appeared as rival makers of sarsaparilla, although there was always a doubt about the existence of Dr. Jacob Townsend. Both (always assuming that there were two) took advantage of the belief in the curative quality of sarsaparilla, then newly made known to the public, and claimed that their preparations would cure every ill that flesh is heir to. It was difficult for the public to understand the controversy in the newspapers which followed. Young Dr. Townsend (S. P.) accused old Dr. Townsend (Jacob) of imitating him. The old doctor, on the contrary, insinuated that the young doctor stole his ideas and his methods, and they had columns of abuse and denunciation of each other in the papers, and were the largest advertisers of the day; but the mystery surrounding Dr. Jacob Townsend has never been solved. Despite the amusing and mixed condition of the Drs. Townsend, the public continues to have great faith in sarsaparilla, and the manufacture of it is still a source of wealth to the old-established concerns. But aside from patent medicines, which were characteristic of the times and the credulity of the people, the drug business had a much sounder basis for existence and progress. Staples, legitimate drugs, were gathered from all quarters of the globe, and as widely redistributed. The development of American commerce was apparent in this branch of commercial activity. Drugs, such as jalap, ipecac, sarsaparilla, and balsams, imported from Mexico, Central and South America, were exported largely to Europe from New York.

In 1820, through French investigation, the separate alkaloids in cinchona bark—quinine, cinchonine, etc.—were determined, and Pelletier shortly after began their manufacture. About the same time John Farr started a quinine factory in Philadelphia, which was followed at a later day by the building of another in New York by John Currie. Our first supplies of cinchona bark came to us through Spain, but when the ports of South America were opened to our commerce shipments were received direct. A few words might be interpolated here relative to the later history of this most important drug. In 1854 the Dutch government imported some young cinchona-trees and some seeds from South America to Java, where they were planted in the Government Botanical Gardens. It was from this beginning that numerous plantations were set out in the mountains, at proper elevation, which, proving successful, formed the source from which the principal part of the world's consumption is now derived. In India, Ceylon, and Africa plantations were also started, which in a short time increased the supply of bark so greatly that the production exceeded the consumption, resulting in a considerable decline in the market price. In a comparatively few years the prices realized on shipments did not pay the growers for the expense of keeping up their plantations and the cost of transportation. The superior quality of the Java barks, and the low prices accepted for them, tended to reduce the exports from South America, and for the same reasons the shipments of cultivated barks from India and Africa have also been decreasing. For a certain period, while our government continued to tax foreign-made quinine, our manufacturers were able to supply the entire home consumption; but with quinine admitted to our free list in 1879, and the lower cost of manufacture abroad, the foreign makers were enabled to ship their surplus stock to this country. They soon secured a foothold in our market, and now supply more than one half the quinine consumed in the United States.

Stone-oil or Seneca-oil, now known as petroleum, was first found in West Virginia, where it rose to the surface of the ground, heavy and dark; it was locally popular as a liniment. In 1829 a well was drilled in Cumberland County, Kentucky, which yielded a quantity so large as to be then considered a phenomenon. The bulk of it was wasted, but a little was bottled, and sold in Europe under the name of American oil. The device on the label—a derrick—first suggested a means of securing a sufficient supply of crude oil to pay for refining. From so small a beginning has grown an enormous industry, and "a new light has come to the world." From the first it was a medicinal remedy, and later the filtered paraffine residuums have proved valuable, and are known as petrolatum, vaseline, etc. These also have become articles of export, introduced abroad presumably by the demand from our own citizens visiting or residing there.

The earliest mention of the manufacture of drugs in this country is in the instructions given to Sir Francis Wyatt, governor of Virginia, in 1621, to invite attention to the making of oil of walnuts, and to employ apothecaries in its production. The inhabitants were likewise to search for dyes, gums, and

drugs. The South Carolina Agricultural Society in 1785 offered premiums for the cultivation of drugs such as senna, cassia, rhubarb, hops, madder, and figs. But it is vain to attempt the description of individual articles and their employment in those olden days; a word or two may be said, however, of the business methods then current. In the retail branch it was largely "go as you please," and in the wholesale line, sixty years ago, the hours of business were from seven in the morning until nine at night. There were no railroads, and after the opening of the Erie Canal there was a rush of trade in the spring, and again before the close of navigation, so that at such seasons clerks would often be at work until midnight. Mr. Samuel B. Schieffelin informs the writer that he has seen the leading druggists of that time standing at their desks writing late at night, and that he himself often worked until midnight. He says further: "They were generally a superior class of men, of high social position, educated gentlemen, and successful in business; many of them had their country-seats, and some of them kept their carriages."

The selling terms were six months, or five per cent. off for cash. Interest was charged after six months, and sometimes the Southern trade would take an additional six months when the cotton crop failed. But as banking facilities improved credits were shortened. With the outbreak of the Rebellion large amounts outstanding had to be canceled; but though many houses went out of business, comparatively few failures occurred among the wholesale trade. A perusal of the advertisements of wholesale druggists of one hundred years ago gives the idea that their stock embraced a great variety of articles. Stocks of the present day are about as varied; but we find that the old articles of materia medica have been combined and presented in many new shapes, and these, in connection with the thousands of new articles, present to-day a list whose complexity of nomenclature can be equaled by few lines of trade. The extent of drug stocks of a century ago, compared with those of to-day, might be approximated by a comparison of one of the earlier pharmacopœias with the present edition of 1890. That of 1830 will, perhaps, reflect the condition of affairs for two or three decades previous to its issue. In it 272 articles of materia medica are mentioned, and 349 processes are given for preparations, making a total of 621 titles. The "United States Pharmacopœia" of 1890 has 994 titles, and the "National Formulary," a semi-official work of almost equal practical importance, has 435, making a total of 1429 articles or preparations which the apothecary is supposed to be ready to furnish upon demand. In order to further show this comparison, the following table is presented, and some figures are added showing approximately the number of preparations or articles under the same heading now carried in stock by the wholesale druggist of 1895. The latter figures are necessarily only an approximation, and are averages compiled from the price-lists of various manufacturers and jobbers.

STOCK DRUGS IN PHARMACOPŒIAS, 1830 AND 1890.

Articles or Preparations in "United States Pharmacopœia."			Articles or Preparations under Same Headings Listed by Wholesale Druggists.
Article or Preparation.	1830.	1890.	1895.
Acids	7	32	140
Alcohol	1	3	4
Alum	2	2	9
Ammonia	6	7	59
Antimony	4	5	19
Arsenic	1	1	14
Bismuth	1	4	35
Cerates	10	6	17
Confections	7	2	10
Copper	3	1	33
Decoctions	15	3	...
Extracts	20	121	780
Gold	1	1	6
Honeys	4	3	...
Infusions	22	5	...
Iron	5	23	63
Lead	2	5	37
Lime	4	6	25
Liniments	11	9	14
Lozenges	5	15	40
Magnesia	1	5	29
Medicinal waters	8	19	51
Medicinal wines	7	10	35
Mercury	11	12	47
Mixtures	10	4	22
Mucilages	2	4	...
Oils	15	50	185
Ointments	20	23	78
Pills	27	15	500
Plasters	11	13	51
Potassium	10	20	76
Powders	6	9	8
Silver	1	6	19
Sodium	4	23	85
Spirits	6	25	34
Sulphur	3	4	9
Syrups	17	32	202
Tinctures	42	72	267
Vinegars	3	5	11
Zinc	3	10	46

The first column shows, with a few minor exceptions, the classification and number of preparations in the "Pharmacopœia" of 1830; those of the work of 1890 are as follows: acids, 32; cerates, 6;

charta, 2; collodions, 4; confections, 2; decoctions, 3; elixirs, 2; emulsions, 4; extracts, 30; extracts, alcoholic, 1; extracts, compound, 1; extracts, purified, 1; extracts, fluid, 87; extracts, fluid, compound, 1; glycerites, 6; honeys, 3; infusions, 5; liniments, 9; liquors, 24; masses, 3; mixtures, 4; mucilages, 4; oils, fixed, 11; oils, volatile, 39; ointments, 23; oleates, 3; oleoresins, 6; pills, 15; plasters, 13; powders, 9; resins, 5; soaps, 2; spirits, 25; suppositories, 2; syrups, 32; tinctures, 72; triturations, 2; troches, 15; vinegars, 2; waters, 19; wines, 10.

The wholesale druggist of fifty years ago carried, as do his successors of the present day, many articles not mentioned in the pharmacopœias of that time, and this feature of the business has so rapidly increased that reference to recent price-lists of prominent jobbing-houses shows an average number of 5700 articles in the department of drugs, chemicals, oils, etc., and of 7600 articles in the department of "patent" or proprietary medicines. If the vast number of articles known as "druggists' sundries" were included the figures first quoted might be doubled, and by including the large number of secret proprietary medicines with which the country is flooded, but which are confined to local trade and do not appear upon general price-lists, the figures upon patent medicines would also probably double; so that it seems fair to estimate that the drug trade of to-day handles 25,000 articles.

One notable feature distinguishing the methods of the drug trade of to-day from those of a century ago is the division of manufacturing into distinct departments. The retail apothecary was then depended upon to prepare from the crude material the medicines required by the physician. To-day, while his knowledge must include an acquaintance with all processes, his convenience impels him to buy the greater portion of his stock in such a stage of manufacture as renders it ready for dispensing. This has caused the building up of the business of manufacturing pharmacy, developed most extensively during the last quarter of a century, and the partial development of the manufacture of chemicals.

A review of the drug trade would be incomplete without some data respecting the progress made in chemistry, for in no other branch of physical science can such advancement be chronicled as in this. It is scarcely one hundred years since Priestley laid the foundation of our modern chemistry by the discovery of oxygen, that most abundant of all elements. To Scheele chemistry owes many of its early and most important discoveries, some of which, like glycerine and prussic acid, were of great value to the pharmacist. Lavoisier, the unfortunate French chemist who was beheaded in 1794, is also deserving of mention as one of the fathers of modern chemistry. The discovery of morphine by Sertürner in 1804, and the discoveries of strychnine and quinine some years later by Pelletier and Caventou, were of vast importance and interest to the physician and pharmacist, furnishing as they did the active ingredients of valuable remedial agents, and serving as examples of the value of alkaloids and their salts. One of the important alkaloidal discoveries of later and recent years was cocaine, which, in the shape of muriate of cocaine, is very extensively and successfully used as a local anæsthetic. Laughing-gas, chloroform, ether, and their application as anæsthetics, have played so important a part since their discovery as alleviators of the sufferings of humanity, that anæsthesia, an American discovery, and modern antiseptic surgery are ranked with the greatest achievements of the nineteenth century.

The evolution of organic chemistry is one of the scientific triumphs of the latter half of the century. The discovery by Wöhler in 1828 that urea could be manufactured artificially from isocyanate of ammonium was the first step in the synthetic production of organic compounds, for until that period chemists held that no organic compound was possible except through the medium of "vital force." Since 1828 innumerable compounds of an organic nature have been prepared synthetically, and many of them are of such importance that they are produced commercially in extensive quantities, as, for instance, alizarine, the chief coloring principle of madder root, of which perhaps $15,000,000 to $20,000,000 worth are manufactured annually; oxalic acid, formerly prepared from the juice of the sorrel, is now made at one tenth its former cost from sawdust and caustic soda; while salicylic acid, instead of being derived from oil of wintergreen, is now produced by the action of carbon dioxide upon carbolic acid and caustic soda.

The chemist has not only been enabled to prepare many of the organic compounds in his laboratory, but during the past ten or fifteen years a vast number of new and interesting synthetic chemicals which plants and animals do not produce (such as antipyrine, exalgine, phenacetine, etc.) have been discovered. This number is continually increasing, and many of the compounds are of importance therapeutically, and of much interest to the druggist and the drug trade. So great has been the advancement

of synthetic chemistry that the chemist of the present day is willing to predict that it is only a question of time when he will be in a position to produce every organic molecule synthetically.

All this progress, this discovery in allied science and labor, has of necessity exerted a powerful influence upon the drug trade, and contributed in no small degree toward making it what we find it to-day. But other agencies, other factors, have been equally operative and effective in molding and shaping it. Of the first in importance among these agencies in its direct effect upon the retail trade, and through it upon the wholesale branch, has unquestionably been the "United States Pharmacopœia."

During the three or four decades following the year 1795 the handling of drugs was carried on in a manner which would be far from reassuring to the invalid of to-day. Between 1810 and 1820, however, was inaugurated a movement which may be designated as one of the most important of the century—that of an authoritative agreement, upon the part of those dealing in and prescribing drugs, regarding the identity and purity of the various medicinal agents then in vogue. This movement resulted in the appearance in 1820 of the "United States Pharmacopœia," a work which has passed through successive decennial revisions up to the present time, and which is recognized as the standard in all the various manipulations of drugs and chemicals, from the identification of the crude material to its proper preparation for the use of the invalid. Although this great work is the result of what might be called private initiative or purely scientific devotion, and is essentially the work of a distinct professional class, it has received governmental recognition to such an extent that the statutes of most of the States recognize it as an authority in legally determining the purity of drugs sold; and as a contribution to the literature of applied science it receives the indorsement of the medical and pharmaceutical professions of all countries. Another successful movement was inaugurated during the period between 1820 and 1830, by the trade and profession as represented by the then newly established colleges of pharmacy at Philadelphia and New York, having for its object governmental inspection of imported drugs, a function which is still exercised by the national government, to the great benefit of all concerned.

From these two movements, which marked what might be called the starting-point for the immense development, both commercial and professional, of pharmacy in this country, may be traced the additional legislation, tending to promote the establishment of correct trade standards, which now appears upon the statute-books of most States, and is known popularly as the "Pure Food and Drug Laws." At the present time such legislation is receiving much earnest attention from the press, the public, and the trade, and unfortunately its assumed theoretical advantages are hampered by suspicions of undue political influence or of governmental paternalism. In keeping with this general trend of affairs are the laws of the various States regulating the handling and sale of drugs, chemicals, and poisons at retail. As it becomes more apparent that skill and experience in handling such articles are necessary to the public welfare, this class of legislation receives increased attention. This feature of the drug-trade history of this country is one of comparatively recent growth, the first law having been passed by Rhode Island in 1870, since which time all the States, with but few exceptions, have taken similar action. Although there is a lack of uniformity of detail in such laws, their effect is to restrict the dealings in drugs and the compounding of prescriptions to those who are able to bring satisfactory evidence of their qualifications before a board of pharmacy, which is authorized to license those whom it deems qualified to engage in the business. The beneficial effect of such legislation is at present only partially felt; for it was decided, as a matter of justice, upon the enactment of such laws, that all those already engaged in the business should be allowed to continue without reference to the new conditions imposed, and as a consequence there are yet many in the retail trade whose qualifications have not been officially determined. But this is a condition which a few years will serve to set right.

The necessity for the better educational qualification of those engaged in the drug business being recognized, the first college of pharmacy—that of Philadelphia—was founded in 1821. In 1826 it graduated three students. During last season its students numbered 757, of whom 197 graduated. The New York College of Pharmacy was organized in 1829, and at about this time colleges were started in Baltimore, Boston, and Cincinnati. There are now about fifty institutions in the United States and Canada where instruction in pharmacy is given, twenty-four of which are regular colleges or schools of pharmacy, the others departments of pharmacy in universities. The first department of pharmacy in a State university was that of Michigan, founded in 1868. During the past year 4200 students—125

of whom were women—attended these schools and colleges of pharmacy, and of this number 1100 were graduated.

Associations or organizations for the conservation and advancement of the material and professional interests of the drug trade have exercised a powerful controlling influence. The first organization was effected in the retail branch when, in 1852, twenty-one active men formed themselves into the American Pharmaceutical Association, having for its object the advancement of pharmacy through increased educational facilities, and the formation of a body which should represent the then newly recognized professional side of the drug business in its relations with the medical profession. This object has been attained in the most gratifying manner, and the list of membership includes the names of the ablest men who have been or are identified with the scientific advancement of pharmacy. The association holds annual meetings for the discussion of scientific questions, trade and educational matters, and has a membership of 1533. One of the features of its work is the annual publication of its proceedings, which contains a review of the scientific progress of pharmacy. Volume xlii., embracing the year ending July, 1894, is a work of nearly 1400 pages, of which 815 are devoted to the progress of pharmacy during the year. Other organized bodies in the retail ranks are the State pharmaceutical associations, the oldest of which is that of New Jersey, founded in 1870 with 44 members, but which now has 350. There are at present forty-six such State associations.

In the wholesale drug trade a notable event of the century was the formation, in 1876, by many of the Western wholesale firms, of an association named the Western Wholesale Druggists' Association, called into existence by the demand of the times. The Civil War caused expansion, which was followed by collapse and a general unsettling of all trade relations. To hold trade, competition became sharp, and concerns that had been doing a prosperous business found it impossible to make profits. A meeting was held in Indianapolis, which was attended by a majority of the prominent druggists of the neighboring cities; and, although no positive action was taken at that time, a better feeling was created. Shortly afterward, at a special meeting, a committee was appointed to try to put into effect what is now known as the "rebate plan." This system was planned and adopted by the proprietors of patent medicines and the wholesale druggists to enable the latter to get a fair profit on patent medicines, which they had formerly been obliged to sell on very close margins. Buyers had to sign a contract that they would maintain established prices, and by so doing were entitled to ten per cent. discount, or rebate, on the wholesale price; but should they sell at cut rates, they would be placed on a "cut-off" list and be debarred from buying from the proprietors.

In 1882 many of the Eastern druggists joined with those of the West at a meeting held in Cleveland, and the name of the association was changed to the National Wholesale Druggists' Association. The following year its first meeting was held in New York. While the various committees have worked hard and reported annually on matters of trade interest, such as the national bankrupt law, fire-insurance, legislation, credits, etc., the committee on rebates has really effected the most important change in trade matters. Up to that time there had not been more than a dozen large distributing centers in the United States; now, by the working of the rebate system, almost all towns of 50,000 inhabitants have one or more wholesale druggists, who are placed on an equal footing with the largest buyer, and each one supplies the retailers in his neighborhood. The National Wholesale Druggists' Association now numbers 258 active and 153 associate members.

One of the undoubted factors in the growth of the drug trade in this country is the pharmaceutical press. It has fostered a spirit of emulation by presenting records of current scientific investigation and progress, and has been a means of bringing the members of the trade or profession into closer touch and sympathy. The people of the United States are said to be the greatest readers in the world, and the large number of ably edited journals devoted to pharmacy shows that the druggist is no exception to this rule. Prominent on its list of publications are the following monthly journals: the "American Journal of Pharmacy," Philadelphia; the "Druggists' Circular and Chemical Gazette," New York; "Pharmaceutische Rundschau," New York; the "Western Druggist," Chicago; the "National Druggist," St. Louis; and the "New England Druggist," Boston. Of semi-monthlies may be mentioned the "American Druggist and Pharmaceutical Record," New York; and of weekly publications, the "Pharmaceutical Era," the "Shipping and Commercial List," and the "Oil, Paint, and Drug Reporter," all of New York. In addition there is a considerable number of similar publications issued by the various colleges and societies and by several of the prominent drug and manufacturing firms.

John McKesson.

There are also several devoted to the allied sciences of chemistry, botany, microscopy, etc.

Leaving this phase of the subject, it would be well to make a comparison, hasty and necessarily imperfect, between the conditions governing trade a century ago and those prevailing to-day. In those days the apothecary cut and rolled his pills by hand, and made his plasters with a "spreading-iron." To-day machinery greatly simplifies these operations, and the manufacturing pharmacist by power-machines is enabled to turn out 100,000 pills per day, and plasters *ad libitum*. For making compressed tablets power-machines are used which turn out 500 tablets per minute. Seidlitz powders are mixed, measured, and put up in packages by machinery, and bottles are filled, corked, and labeled by similar means. Marvelous has been the progress in operative, manipulative pharmacy, and the benefit to the drug trade from the results of inventive skill is shown when we consider that the combined rating of 270 wholesale druggists and manufacturers of chemicals and pharmaceuticals is nearly $50,000,000. Of these, eleven are rated at $1,000,000 each; over twenty-nine up to $500,000 each; thirty-seven at $250,000 each; and the balance from $20,000 to $25,000 each. There are eight large factories engaged in manufacturing fine chemicals, and over a dozen firms making pills and other pharmaceutical preparations on an extensive scale. It is stated in the census report of 1890 that the production of pharmaceutical preparations then amounted to $16,747,043; it would be fair to say that it now amounts to $20,000,000.

Let us enumerate a few of the most noteworthy improvements: Fluid extracts, as constituting a class of pharmaceutical preparations, are essentially an American invention. They are made by percolation or displacement, a process in which the powdered drug in a suitable vessel is deprived of its soluble constituents by the descent of a solvent through it. The value of this process cannot be overestimated, as the progress made in pharmacy in America during the last half-century is largely due to the study and development of percolation, and the introduction of preparations which are the direct outgrowth of the process. Percolation was made official in the "Pharmacopœia" of 1840, and has been continued in the various revisions of that work to the present time. None of the pharmacopœias preceding that of 1850 gives formulas for the preparation of fluid extracts; in that year only seven formulas were given; in 1860 the number was increased to twenty-five, and in the present edition there are eighty-eight. This number does not at all represent the great variety of fluid extracts manufactured, for they have become almost as numerous as the vegetable drugs in popular use. Another innovation is the elixirs, which are aromatic, sweetened, spirituous preparations containing small quantities of active medicinal substances. The term "elixir," used by manufacturers as designating a class of pharmaceutical preparations, was introduced prior to 1840, but the first formula published under the name "elixir" for the use of the druggist did not appear until 1859. During the seventies the popularity of this kind of medicament had reached its height, although elixirs of various kinds are still largely prescribed.

In the adaptation of labor-saving machinery to the manufacture of pharmaceutical preparations the American inventor has found a field worthy of his genius, and of the greatest importance to the pharmacist. A century ago the old-fashioned iron or stone mortar for powdering drugs was to be found in every pharmacy. Drug-milling, as understood to-day, was then unknown. Iron and stone mills have been superseded by new machinery which has greatly improved the quality of the product and cheapened the cost of production. Among the most important innovations is the process of grinding by attrition. Rapidly revolving arms in a cylinder soon reduce the introduced substance to any degree of fineness desired. For substances more friable, the rumbler, a revolving cylinder inside of which are porcelain balls, works better, and it requires very little attention. Centrifugals have also brought about great changes in chemical production, and percolators have displaced the wide-mouthed jar and stirring-stick.

Sugar-coated pills were first made in this country by the Tilden Company, of New Lebanon, N. Y. In a recent interview with the president of the company, S. J. Tilden, he told the writer that he had some filled capsules of copaiba and cubebs made over forty years ago, which were as good as they were the day they were made up. The popularizing of gelatine capsules as a means of administering nauseous remedies in a readily assimilable condition is largely due to American push and inventive genius. The process originally outlined for their manufacture was that of Mothes, of Paris. H. Planten & Son claim to have been the first to make and introduce them in the United States. In the early seventies the invention of improved machinery for their manufacture gave the industry a strong impetus, and the business became one of magnitude.

Pure fruit-juices have become a very important article to the retail drug trade. For making "soda-water," fruit flavors from artificial essences were for a long time used, until more cultivated tastes required the natural flavors. The manufacture of these is now carried on on a large scale, and great quantities of fruits, which sometimes become a glut on the market, are thus utilized.

In special fields of manufacturing pharmacy the development of new ideas and processes has been equally prominent. Perhaps one of the most interesting of these special developments has been that characterizing the discovery, commercial exploitation, and rapidly increasing commerce in what are known as the digestive ferments, of which pepsin is the best known. In keeping with the crude speculative views of the ancients on all physiological phenomena, the most absurd theories were advanced to explain the process of digestion in the stomach. It was not until the first quarter of the present century had nearly elapsed that the correct conception of the nature and agencies of the digestive secretions and process was reached, namely, that the solvent action upon food is due to certain peculiar, soluble organic principles or ferments.

Consideration of the commercial and practical application of these digestive ferments leads us easily to America; for here the commercial importance of pepsin and the other digestive ferments is far greater than in any other country, and in America their value and practical usefulness as therapeutic agents and in the artificial digestion of foods have been most fully developed. In physiological chemistry we owe a great debt to the researches of the chemists of the older countries, especially France and Germany; yet the practical significance and promise of these researches have been most clearly conceived and realized by American invention, sagacity, and enterprise. It was an American surgeon, Beaumont, who made (1825–33) the famous classical observations upon the phenomena of digestion in the living stomach, which revealed the functions of the gastric juice and did much to stimulate and suggest the direction of subsequent inquiries. The active principle of the gastric juice was discovered by Schwann, 1836, to which he gave the name of pepsin, although unable to separate it; diastase by Payen and Persoz, 1833; the albumin-digesting ferment of the pancreas, described by Corvisart, 1857–58, but not accepted until confirmed by Kühne, 1867, who separated the ferment and named it trypsin; the emulsive ferment by Eberle, 1834. The history of American commerce in pepsin practically begins with the introduction of Scheffer's pepsin, 1872. Scheffer has the merit of proposing the simple and practical "salt" process, which, being a great improvement over previous methods of obtaining the ferment from the stomach, was soon widely adopted. Pepsin prepared by this method appeared in commerce principally as "saccharated pepsin," the ferment being incorporated with a large proportion of milk-sugar. In 1879 Fairchild introduced the original form of pepsin in scales, "free from added substance or reagents." The appearance of this pepsin of phenomenal strength, with the recognition of the fallacy of administering the ferment in the largely diluted form then in vogue, was the signal for great activity in the manufacture and improvement of commercial pepsins. The obvious importance of stomach digestion naturally directed attention chiefly to the stomach ferments, and the medicinal use of the digestive ferments still remains popularly identified with pepsin; yet the other digestive ferments, especially those of the pancreas, possess far wider scope of activity and are relatively of wider importance. Practical recognition and application of these pancreas ferments must fairly be attributed to Fairchild, who in 1880 introduced the *extractum pancreatis*, containing diastase for the conversion of starch, trypsin for the conversion of albumin, the emulsifying ferment for the digestion of fats, and the milk-curdling ferment. Fairchild demonstrated the very remarkable practical value and adaptability of these pancreas ferments, especially in the artificial digestion of foods for the sick.

In the preparation of infant foods both diastase and trypsin have been extensively employed. In view of the indigestibility of starch for infants, Liebig proposed that the farinaceous foods commonly used with milk as food for infants should first be predigested into soluble form by means of malt diastase. In 1884 Fairchild proposed a method of modifying and adjusting cows' milk to a resemblance to human milk in digestibility and composition. Fairchild's method is based upon the conversion of caseine, by means of trypsin, into the soluble and peptone-like bodies which give to human milk its peculiar digestibility, in contrast with cows' milk. Pepsin now appears in a great number of popular as well as officinal forms, and is prepared generally by pharmaceutical manufacturers everywhere. We have in the United States the only house in the world engaged, as an exclusive specialty, in the manufacture of the digestive ferments and predigested foods.

The digestive ferments occupy a brilliant position in modern therapeutics, and the progress of physio-

logical chemistry suggests still further utilization of the animal organic principles, as recently shown in the successful and important treatment of disease by the thyroid gland.

The india-rubber porous plaster, which was the first improvement made on old methods of applying plaster masses to the human body, was invented by Dr. Shecut, a naval surgeon, who attempted to popularize it with the aid of Horace Day, known in the rubber trade. They conducted the business under the name of Day & Shecut, but later sold it to Thomas Allcock, who was in the employ of James Aspinwall. Allcock failed to make it a success, and sold out to Dr. Brandreth. There were a number of manufacturers of plasters doing business at that time, whose products were made chiefly of isinglass and resinous mixtures, the latter being spread on cloth and plaster skins. Besides there were several makers of common adhesive plasters in five-yard rolls. In this group the following are the most familiar names: Ellis, Husband, Davidson, De la Cour. Of the makers of isinglass, court, corn, bunion, and kid plasters should be mentioned Robbins, Mitchell, Littlefield, Wells, Herrick, and Holloway, who all made specialties of certain lines.

About 1867 Seabury & Porter commenced to experiment with rubber, in order to introduce a general line of improvements. In those days, and up to 1876 or 1877, many of the mixtures were in solution, and the plaster mass was spread on frames with a brush, then cut, and made porous. Seabury was the first who conceived and practically worked out the idea of the use of rubber in medicinal and surgical plasters. All pioneer manufacturers have their trials and tribulations before they perfect their work, but the beginning of the great object striven for was attained when the firm changed from rubber solutions to the mechanical working of plaster masses. Later the firm name was changed to Seabury & Johnson.

Another distinctively American form of medication unknown to our forefathers was introduced in 1878 in New York by Dr. R. M. Fuller, under the name of "tablet triturates." These preparations are made by triturating the active ingredient with either plain sugar of milk or a mixture of sugar of milk and cane-sugar, forming the mixed powders into a paste and pressing the paste into tablets in appropriate molds. In this way small quantities of potent remedies, such as alkaloids, concentrations, etc., could be administered in convenient, palatable, and readily soluble form. The idea was a taking one with the medical profession, and manufacturers began to produce them upon an enormous scale. An idea of the magnitude of this work may be gleaned from the statement that a single manufacturer lists no less than 500 different varieties of these preparations.

These instances of development in individual lines prepare one for a presentment of statistics showing the magnitude of the commerce in which the drug trade is to-day engaged. One of the advantages secured by the organized trade bodies that have come into existence during the past fifty years has been the keeping of statistics and the recording of current history. If such organizations had existed a hundred years ago the work of the present compiler would be comparatively simple. Our government did not keep records of imports and exports of drugs prior to 1830, and even then the list comprised but few items. The exports of medicinal drugs from the United States were then stated as $130,238. For the year ending September 30, 1835, they were reported at about $200,000, whereas last year the exportations of medicines of all kinds amounted to about $8,000,000. Of these, ginseng root alone amounted to 233,236 pounds, valued at $826,713, all of which was exported to China. Our own continent and the West Indies have been the only fields for exports as far as the introduction of our manufactured articles is concerned. Except for a few specialties, Europe has taken our simples only. Probably tobacco was the earliest indigenous drug exported, and its consumption has so increased that it is now of sufficient importance to be classed by itself. Oil of peppermint, which we find quoted in 1804 at fifty cents per pound, for the past few years has been selling at from $1.50 to $3 per pound. It was first cultivated in New York State about seventy-five years ago; and the exports of this product last year amounted to 93,879 pounds, valued at $244,716.

The statistics of imports earlier than 1835 are wanting, and for that year only camphor, 62,134 pounds, castor-oil, 471 casks, and opium, valued at $172,415, are enumerated. For the fiscal year ending June 30, 1875, the Bureau of Statistics reported the importation of drugs, chemicals, and dyes at $38,263,067, and for the fiscal year ending June 30, 1895, at $45,552,569. In these figures crude drugs and manufactured articles are combined. That the imports in 1895 do not more largely exceed those of 1875 may be accounted for by the increase in the number of our home producers, who now supply many articles formerly imported. For comparison the importation of a few selected articles is given, which will afford an interesting study.

COMPARISON OF LEADING IMPORTATIONS, 1876 AND 1895.

Article.	Average Imports of Five Years Ending June 30, 1876.	Average Imports of Five Years Ending June 30, 1894.
Bark cinchona	4,446,563 lb.	2,810,422 lb.
Camphor crude	854,962 "	1,746,017 "
Ext. licorice	1,777,715 "	1,031,070 "
Magnesia carb.	168,958 "	64,643 "
Manna	22,726 "	34,756 "
Morphine	1,934 oz.	28,186 oz.
Nux vomica	364,995 lb.	1,455,446 lb.
Oil anise	16,468 "	38,152 "
" bergamot	42,642 "	54,645 "
" cassia	52,186 "	51,263 "
" castor	1,852 gal.	2,269 gal.
" citronella	47,592 lb.	338,649 lb.
" croton	4,735 "	106 "
" lavender	36,320 "	97,560 "
" lemon and orange	70,642 "	210,996 "
" olive	131,222 gal.	620,599 gal.
" " salad	175,103 "	629,637 "
" rose	10,018 lb.	40,356 lb.
Opium	185,962 "	583,777 "
Pitch Burgundy	39,178 "	238,882 "
Quicksilver	123,445 "	250,065 "
Quinine	52,185 oz.	2,784,973 oz.
Root gentian	57,585 lb.	210,731 lb.
" jalap	60,466 "	106,633 "
" licorice	10,182,531 "	74,430,002 "
" orris	41,345 "	190,931 "
" rhubarb	72,411 "	115,106 "
" sarsaparilla	646,517 "	716,214 "
Seed canary	54,060 bush.	108,673 bush.
" caraway	576,694 lb.	1,312,012 lb.
" cardamom	29,838 "	42,039 "
" castor	1,466 bush.	111,440 bush.
" mustard	1,390,540 lb.	2,689,884 lb.
Senna	180,365 "	51,457 "

A few leading articles are worthy of individual and more extended consideration. Among these one of the most important is opium. The earliest government statistics value the importation of this drug for the year ending September 30, 1835, at $172,415, but the number of pounds is not stated. Probably the cost per pound was much higher than at the present day. During the year ending June 30, 1895, crude opium to the value of $730,669 was imported, representing 388,455 pounds. This, however, is below the average quantity imported during several preceding years. When we take into consideration the increased quantities of morphine and opium now imported, together with the many new remedies for pain and sleeplessness that have been brought into use, we may form a slight idea of the terrible strain our nervous organism is subjected to as compared with that of our ancestors. The average importation of opium for the years 1869, 1870, 1871, viz., 90,000 pounds, has increased to 562,618 pounds, the average of the years 1892, 1893, 1894; and the average importation of morphine, covering the same period, has increased from 1934 ounces to 30,000 ounces.

To show further the extended use of narcotics, we find the average importation of opium prepared for smoking, for the same period, was 14,333 pounds, against 74,151 pounds. Last year the importation of "smoking-opium" greatly exceeded that of any previous year, amounting to 139,765 pounds; of this, 35,638 pounds were carried over in bond at the end of the fiscal year, making the amount entered for consumption 104,127 pounds. It would hardly seem possible that the actual amount consumed could increase so suddenly, and the only deduction is that some speculation has taken place in the article on the Pacific coast, and that the government has been more vigilant than heretofore in stopping smuggling.

IMPORTS OF OPIUM DURING THE PAST TEN FISCAL YEARS.

Year Ending June 30th.	Pounds.	Average Import Cost per Pound.
1886	471,276	$2.20
1887	568,263	2.35
1888	447,020	2.76
1889	391,563	2.07
1890	473,095	2.29
1891	621,749	2.54
1892	587,924	1.76
1893	612,519	1.92
1894	716,883	2.36
1895	358,455	2.04

Cinchona bark has touched during the current year, in the public sales at Amsterdam and London, the lowest figure ever known; and quinine in 1892 also reached its lowest limit, seventeen cents per ounce. Since the above date the surplus stock of quinine has been greatly reduced, and during the past year the market has ruled at from twenty-four to twenty-five cents per ounce. For the fiscal years ending June 30th the importations of cinchona bark were as follows:

IMPORTATIONS CINCHONA BARK, 1885 TO 1895.

Year Ending June 30th.	Pounds.	Value.	Average Cost per Pound.
			Cents.
1895	1,911,489	$117,297	6.2
1894	2,502,224	143,194	5.7
1893	2,374,041	196,867	8.3
1892	3,423,941	299,998	8.8
1891	2,672,364	301,085	11.3
1890	2,838,306	282,737	9.9
1889	2,878,184	371,532	12.8
1888	2,801,457	344,718	12.3
1887	4,787,311	741,830	15.5
1886	4,447,082	925,744	20.2
1885	3,559,691	913,189	25.7

For comparison we add a table of importations of sulphate of quinine for ten years, ending June 1st:

IMPORTATIONS QUININE, 1886 TO 1895.

Year Ending June 1st.	Ounces.	Value.	Average Value per Ounce.
			Cents.
1886	1,251,556	$887,599	71
1887	2,180,157	1,098,547	50
1888	1,603,936	647,654	40.5
1889	2,825,008	917,322	32.5
1890	2,990,239	886,430	29.7
1891	3,079,000	805,821	26.1
1892	2,686,677	542,440	20.2
1893	3,027,819	556,782	18
1894	2,141,130	740,816	21.9
1895	1,420,649	342,348	24.1

Senega or snakeroot has become a popular drug. It was formerly found in the Eastern States, but is now found in sufficient quantities to pay for digging only in Minnesota, Dakota, and Manitoba, except some small quantities that come from the South. This root was quoted at twenty-five cents one hundred years ago. It went up to sixty cents, but during the last five years has declined, until now it is at the old figure. The annual production is estimated at between 300,000 and 400,000 pounds, and about one third the amount now gathered goes abroad to meet the increasing foreign demand. Serpentaria, or Virginia snakeroot, as it is sometimes called, comes mainly from Texas. This was quoted in 1804 at twenty-five cents, and during the past five years it has fluctuated between twenty-two and thirty cents. A demand exists for it for export, as also for goldenseal, sassafras, and mandrake roots, damiana and lobelia herb, and slippery-elm bark; but of all the indigenous drugs exported, cascara-sagrada bark probably is the largest in quantity, although ginseng root doubtless leads in value.

Borax, although not an article of export, has considerable importance as a home product. Formerly our supply came from England or indirectly from Italy. It was first discovered in California in 1856, and later in the deserts of Nevada; now these two States supply the country. Before 1872 borax sold at from twenty-eight to thirty-five cents per pound; since then the increased production has brought the price down to between five and eight cents per pound.

Although we are still large importers of drugs and chemicals, the reason for this is a purely economic one, or rather it is a matter of convenience. The natural resources of the United States will, when developed, furnish nearly everything in the way of medicines. Borax has been cited as an example, but there are many others, especially those materials which enter into the inorganic compounds, and which are easily accessible, such as quicksilver, iron, lead, copper, zinc, aluminum, sulphur, lime, potash, soda, gold, silver, manganese, etc. With a climate ranging from frigid to torrid, nearly all the medicinal products of the vegetable world could with proper care be propagated in this country. Experiments with camphor, cork, licorice, opium, olives, and other foreign plants have demonstrated this fact.

It only remains to mention the personnel of the drug trade of long ago and that of to-day. We have no data as to the number of druggists doing business in the United States a hundred years ago; but though there are now 38,000 in the country, the New York City Directory of 1786 gives the names of only five. On Queen Street, now a part of Pearl Street, there were two, Effingham Lawrence being at No. 227, and Besley & Goodwin at No. 228. Hanover Square had three: at No. 23 was Francis Wainwright; at No. 24, Timothy Hurse; and at No. 26, Oliver Hull. Effingham Lawrence was the druggist and apothecary to the Medical Society, a committee of which examined his store quarterly and certified that his drugs were genuine and his medicines faithfully prepared. Two wholesale drug houses of the present day were founded about a century ago, but only one of these continues under the original name, though quite a number date back fifty or sixty years. The principal houses of that day were Lawrence & Keese, J. A. & W. B. Post, Thomas S. Clark, John & William Penfold, John M. Bradhurst, R. & S. Murray, Silas Carle, John C. Morrison, and Olcott & McKesson.

The firm of Schieffelin & Company, of New York City, is the oldest house in the drug line continuing under the same name in this country. It was founded by Jacob Schieffelin in 1794, and has been continued by his descendants. Mr. S. B. Schieffelin, the oldest living representative, now retired from active business, was a lifelong friend of the father of the writer, to whom it gives great pleasure to testify to the long and honorable career of a worthy house. Business in the past generation seems to have had one specially pleasant feature, and that was the fraternal relation that existed between the different houses. The oldest and best friends of the writer's father were his competitors in trade.

The firm of Powers & Weightman, of Philadelphia, was established in 1818 as Farr & Kunzi. In 1821 they purchased the property still occupied by

the present firm; it was then fairly on the outskirts of the city. Mr. Kunzi retired in 1838, and two years later Mr. John Farr took Mr. Powers and his own nephew, Mr. Weightman, into partnership. After the decease of Mr. Farr, in 1847, the firm became Powers & Weightman. Mr. Thomas H. Powers died November 20, 1878, but the firm name has continued unchanged. The history of this firm is identical with the history of the growth of chemical manufacture in America. Commencing in a small way, its great business has been reared by legitimate enterprise, and its reputation made solely by the excellence of its products and its upright business dealings. Mr. Farr, as before noticed, was among the first to manufacture quinine in the United States. He was, in fact, pursuing investigations of the alkaloids contained in cinchona bark about the time that the discovery of quinine by Pelletier, in France, was announced to the world.

McKesson & Robbins, of New York, established in 1833 under the name of Olcott & McKesson, were the first to make and introduce gelatine-coated pills. They were also the first drug house to start an extensive separate laboratory to manufacture a general line of pharmaceutical preparations in a large way with improved methods, and they have kept step with the advance in pharmacy. In order to facilitate the carrying on of the firm's increasing business the system of departments was adopted by the house. Some of these are: the importing of drugs and chemicals; the buying department; the manufacturing of pharmaceutical preparations; the making of chemicals; the cork factory; the drug-grinding department; the printing department; the export department for supplying the West Indies, Central and South America, and another for Europe, Asia, and Africa; one for supplying city pharmacists, and one for out-of-town buyers; one for fancy goods, and one for sponges. Over 450 persons are employed by the firm.

As is natural, much of the early history of the drug business in this country centers around Boston. Half a century ago there were in that city sixty-seven drug-stores. Of these about a score are still on the precise spots where they were situated in 1845, or are still carried on under the same names, but in new places. Perhaps the most interesting relic of the old days is the store of the Theodore Metcalf Company, for the founder was engaged actively in business until his death a comparatively short time ago. At present there are two stores bearing his name. Another sign familiar to the residents of fifty years back was that of T. Restieaux, a modern copy of which is still to be seen on Tremont Street, near Metcalf's. On Green Street may be seen the shop where for a good half-century Emery Souther has been and still is dispensing medicines. On Hancock Street Ashel Boyden's store is carried on by his son. What used to be William Brown's store, at the corner of Washington and Eliot streets, is now owned by William B. Hunt. Carter, Carter & Kilham are the direct successors of the house which, in 1845, bore the name of Carter & Wilson, and was in business on Hanover Street, not far from where the firm is now situated. A drug-store on Prince Street, originally H. D. Fowle's, is now owned by Alfred W. Tilton. George W. Colton's shop, on Cambridge Street, near the bridge over the Charles, which was a landmark for Harvard students, still exists. So, too, do the old stores of D. Henchman and T. Larkin Turner, on the same street, though they have since passed through the hands of several owners. Charles E. Eames carries on to-day the shop at the corner of Hanover and Charter streets, over which W. P. Howard formerly presided. In Maverick Square, East Boston, James Kidder had a drug-store which is open even to this day. Littlefield's pharmacy, in the United States Hotel, has been kept up all these years, with Chapin & Company as the present owners. Dr. R. C. McDonald's Parmenter pharmacy, on Hanover Street, was the modest drug-store of G. W. Parmenter in the forties. John Southwick's shop, on Tremont Street, at the corner of Eliot Street, is to-day Joseph L. Parker's. As far back as 1826 what is now the house of Cutler Brothers & Company was established by Lowe & Reed, so that the firm claims to be the oldest wholesale importing and jobbing drug house in New England. In 1861 the firm became Reed, Cutler & Company, through later changes acquiring its present name. The drug house of Thomas Hollis is one of the oldest in Boston, the stand at 23 Union Street, with the sign of the Golden Mortar, having since 1826 been favorably known to the citizens of Boston and New England generally. The founder, Thomas Hollis, died in 1876, and his sons, Thomas and Francis Hollis, continue the business under the old name.

The first drug-store in Washington was opened in 1796 by Frederick Miller, but its location cannot now be identified. Of the firms who have been fifty years or more in business in that city there are now but four. The store of Z. D. Gilman was established in 1822 by Seth Todd, who was succeeded in 1842 by Z. D. Gilman, since whose

death a few years ago the business has been conducted in his name for the widow. The present firm of Sheller & Stevens was established in 1828 by William Gunton, and through a series of successions is maintained now under the name just quoted. Whiteside & Walton's store was established early in the thirties, as was also Thomas L. Crockley's business, whose founder was George W. Sothoron. The oldest druggist now doing business in Washington is Mr. John E. Bates, who entered the business in 1836.

Probably the oldest drug house in the West is that of T. H. Hinchman & Sons, of Detroit, Mich. The business was started in that city in 1819 by Dr. Marshall Chapin, presumably as a branch of the firm of Chapin & Pratt, of Buffalo. In 1833 Dr. Chapin took as a partner John Owen, of Detroit, the firm thus becoming Chapin & Owen. Theodore H. Hinchman went to Detroit to enter the employ of that firm in 1836, was admitted as a partner in 1846, and in 1848 succeeded to the business. His brother, James A. Hinchman, was admitted as a partner in 1852, and continued in business with him until 1860. In 1868, 1869, and 1871 the three sons of Theodore H. Hinchman were admitted to partnership, since which latter date the style has been T. H. Hinchman & Sons. Mr. Theodore H. Hinchman died May 12, 1895.

The earliest Chicago wholesale druggists of whom we have any record are the following, named in the order of establishment: Dr. Clark; Dr. Brinkenhoff, now Peter Van Schaack & Sons; Dr. John Sears; Stebbins & Reed, afterward J. H. Reed & Company; F. Scammon & Company; and Fuller & Roberts, now the Fuller & Fuller Company.

Among the many firms manufacturing medicinal chemicals worthy of mention are: Rosengarten & Son, Philadelphia; Charles Cooper & Company, New York; Charles Pfizer & Company, New York; Mallinckrodt Chemical Works, St. Louis; Larkin & Scheffer, St. Louis; Herf & Frerichs Chemical Company, St. Louis. The most recently established of the chemical manufacturing concerns is the New York Quinine and Chemical Works, Limited. Although this corporation was formed in 1886 only, the quality of its products has placed it in the front rank. It was the first in this country to make, on an extensive scale, caffeine, cocaine, aloin, and acetanilide, and is the second largest American producer of quinine and morphine.

The United States can boast of many extensive laboratories devoted to the manufacture of pharmaceutical preparations. A pioneer in this line was Dr. E. R. Squibb, who in 1854, as a passed assistant surgeon in the United States navy, organized and ran the United States Naval Laboratory, furnishing the medical supplies for the navy for three years. In 1858 he started his present manufacturing business. He has written much, and is considered an authority on matters pertaining to pharmacy. Among other prominent houses in this line may be mentioned the Tilden Company, Lebanon, N. Y. (one of the first); Billings, Clapp & Company, and the E. L. Patch Company, Boston; Sharp & Dohme, and the Burroughs Brothers Manufacturing Company, Baltimore; Henry Thayer & Company, Cambridgeport, Mass.; William R. Warner & Company, John Wyeth & Brother, and H. K. Mulford Company, Philadelphia; Parke, Davis & Company, and Frederick Stearns & Company, Detroit, Mich.; William S. Merrell Chemical Company, Cincinnati, O.; Eli Lilly & Company, Indianapolis, Ind.; Charles S. Baker & Company, and the Searle & Hereth Company, Chicago. In addition, many of the wholesale drug houses maintain extensive laboratories devoted to this branch of manufacturing.

Henry Troemner, of Philadelphia, was, as near as can be ascertained, the pioneer manufacturer of druggists' balances or fine scales. He came here in 1836 from Marburg, Germany, and started in business in Philadelphia two years later. At that time scales for druggists were made to order by jewelers, and were generally of hammered silver, and consequently very expensive. Mr. Troemner sold his first scales in New York City to Mr. Schieffelin. Now the house does a large business in fine scales.

American pharmacy has worthy representatives abroad, the most successful firm being Burroughs, Wellcome & Company, in London, England. Mr. Burroughs received his training with John Wyeth & Brother, and Mr. Wellcome represented McKesson & Robbins for some years in various parts of North and South America, India, and England. As far as New York City is concerned, the number of jobbing druggists has decreased, and much of the importing is now done through foreign agencies. Likewise all the leading manufacturers throughout the country have agencies in this city, which condition tends to divide up the jobbing business; but there is a population of 4,000,000 in its immediate neighborhood to be supplied, in addition to its still being the largest distributing center for the whole country.

Jno. McKesson Jr

CHAPTER XCIV

THE PAINT, OIL, AND VARNISH TRADE

IMITATION of the colors that he found in nature was one of the earliest arts of man. Pigments of one sort or another were known to the rudest nations of antiquity, and every civilization has had its colors and its painters. The crude, earthy ochres with which the savage smeared his body, and the gaudy colors of the Egyptian and the Hebrew, were succeeded by the brilliant tints and lead-bodied oil paints of Rome and Greece. Varnish, whether as the heavy lacquer or japan of China and the island realm of the mikado, or as the waxy preservative beneath which the mural paintings of long-buried Herculaneum and Pompeii still stand forth bright and clear, is of almost equal antiquity. Coeval with all these are the oils, which were recognized in utility and application long before science had learned to differentiate between the animal and vegetable kingdoms, whence their supply was derived.

Between the early civilizations which developed the painter's art and the later era which resumed and carried it to still greater prominence stretches, however, the long break of the dark ages, when Europe relapsed into the barbarism of feudal strife. The fourteenth and fifteenth centuries saw the return of many of the peaceful arts, and among them that of the painter. Then and a little later were developed those wonderful pigments that have left the old masters famous. Never since then have such colors been attained by the artist, and, greatly as modern skill has surpassed them in many respects, the secret which produced some of the glorious and indestructible tints of that time still remains among the lost arts. Apart from its artistic application the use of paints gained but slowly in Europe. Gradually houses and ships took color under the painter's brush, woodwork was preserved by its use, and ornamentation by colors became general. The manufacture and the application of paint became established and recognized industries, and were of considerable importance at the time when the great English companies began despatching colonists to the shores of the New World.

The early American settlers, however, had small use for paint in the wilderness they came to conquer. Log cabins and the roughest mode of life required little of decoration or ornament. They were eminently practical, too, even in the Virginia, Maryland, and neighboring settlements, and so neglected appearances as unconcernedly as the austere and self-mortifying Puritans of the New England colonies. To the commercial rather than to the esthetic side of the colonial character must be attributed, therefore, the first step in establishing the great paint and oil industry of this country. It was in response to home requirements, a strong foreign demand, and the inducement of good prices that the culture of flax, both for the housewife's distaff and to obtain the seed for export, was begun. Once commenced it spread rapidly, and soon in the interior localities, where transportation to the seaport settlements was difficult and expensive, oil-mills were started to crush the surplus flaxseed.

The manufacture of this, the linseed-oil of commerce, was begun in New York in 1715, and three years later John Prout, Jr., commenced it in Connecticut. In 1750 an old record states that the "Dumplers" in Pennsylvania had established among other industries an "oyl-mill." These so-called "Dumplers" were probably the sect of Dunkers in Lancaster County, which view is still further supported by the fact that by 1786 there were four oil-mills in operation in this county and within ten miles of Lancaster. So early as 1774 the first colonial Congress had recommended the growing of flax and the expression of the oil from its seed, and in 1792 this manufacture was established at Easton, Mass. Water, cattle, and wind power were used in operating these early oil-mills, and an annual product of 2000 gallons was very large. The use of

Daniel F. Tiemann.

windmills in crushing the seed was confined chiefly to New York, where the Dutch customs still prevailed. So late as 1790 there was an old windmill which crushed flaxseed in New York City, and was located within a quarter of a mile northeast of the city offices. The price of flaxseed at this time was from two shillings to two shillings sixpence per bushel, and flax was extensively grown throughout all the colonies, and especially in Virginia, Maryland, and Pennsylvania.

The rapid growth of the linseed-oil industry had not been without its effect in stimulating the use of paints. These colors were, however, wholly imported, and grew but slowly in general favor. So intolerant was the prejudice against paint as a badge of worldliness and vanity in the Puritan settlements of New England in 1630 that a clergyman of Charlestown was actually brought before the council on charges of having certain interior finishings of his house painted. Forty years later an official list of mechanics and tradesmen discloses the fact that there was not a single painter in Massachusetts Colony. Nevertheless by 1714 painters' colors were for sale in Boston, and while their employment, even for painting the churches, was frowned upon by the Puritans, they grew slowly in use among the wealthy until the time of the Revolution. In New York whitewashed walls and woodwork painted a sort of bluish gray were quite general so early as 1748, and both here and in Philadelphia the use of paint increased far more rapidly than in New England. In 1767 painters' colors were among the articles taxed in the colonies by England. The disturbance created by this act caused its repeal by Parliament three years later. But to the sentiment aroused by the Stamp Act and this one can be attributed some of the earliest of the symptoms of American revolt.

The Revolutionary War, followed as it was by an internal development necessary to maintain our position of independence, changed conditions in this country very greatly. By 1795, the beginning of the past century of progress, the use of paint had become common. In the towns even the ordinary householder used paint about his dwelling. If he was too poor to indulge in the luxury of an outside coat, the interior woodwork, at least, was painted, and the churches and public buildings all showed the work of the painter. The white house with green blinds was then and for many years afterward the single type of ultra-esthetic decoration. In the New England States, especially in the country districts, this combination of colors is still found as prevalent to-day as it was all over the United States seventy-five years ago. The sole accepted modification of this style was the use of a sort of red paint in the place of the more expensive white. Economy was the only reason for the use of the red, however, and except for school-houses, churches where the congregation was very scanty, and homes where the inmates were poor, the white was always used. The introduction of more tasteful colors and shades and more harmonious tints began early in the present century, but their general adoption as seen in present effects is still a comparatively recent matter.

The first successful attempt to manufacture white lead in this country was made in Philadelphia by Samuel Wetherill in 1804. Red and white lead were made by him of as good quality as that imported, and other manufacturers of these products soon followed him. In 1806 color making was begun experimentally by Anthony Tiemann, who regularly started in the manufacture in 1807. His first products were rose pink, Dutch pink, French green, and blue. The manufacture of Prussian blues was begun in 1809, and in 1820 chrome yellow was added to the products of this firm. This latter color was first made in this country by William Guest, of Baltimore.

Meanwhile by 1811 there were twenty-two different colors of paint being made in Philadelphia, while three small red-lead factories in Pittsburg, the first west of the Alleghanies, were turning out annually a product valued at $13,000. Chrome paints of the first quality commanded in the early days $3 a pound, and their manufacture was a profitable one. Extensive deposits of chromic iron discovered in Chester County, Pennsylvania, gave an added impetus to paint grinding, and its growth was strong and steady.

The succeeding decade saw the industry firmly established in New York. By 1820 there were extensive works in Brooklyn and New York producing red and white leads, chrome and other colors, while a factory in Rensselaer County, New York, was turning out annually $4500 worth of Prussian blue. This establishment used the shavings of leather in obtaining its color, after the process described by Dr. John Pennington in 1790. Factories in Albany, Boston, and other cities, as well as the extensive establishments in Philadelphia, showed how firmly the paint industry had established itself at this time, and the next twenty years brought the natural and resultant development not only of this but of the related manufactures of varnishes and oils.

Prior to 1828 all the varnish consumed in this country was imported. Its use, while less common

than that of paint, was nevertheless sufficiently general to recommend it to manufacturers as a profitable product, and accordingly the first establishment for making it was founded by P. B. Smith at 202 Bowery, New York City, in 1828, and the following year he was joined by a Mr. Hurlburt. This partnership was of brief duration, however, and in 1830 the second factory was established by Tilden & Hurlburt, and was the first permanent concern in the business. In 1836 Mr. Smith removed to Newark, N. J., where in company with D. Price he established the first of the great Newark varnish-works. Another early manufacturer of varnish was Christian Schrack, of Philadelphia, who established the industry in that city.

The first importations of gum copal, direct from Zanzibar and the west coast of Africa, were largely used by Tilden & Hurlburt, and this firm was the first to export American varnish, they consigning a quantity to South America and Mexico in 1836. The quality of the American goods proved so exceptional that they not only competed with, but to a great measure supplanted, the exportations of the European manufacturers. The stimulation of a heavy foreign demand joined to increased domestic consumption so augmented the business that the matter of obtaining supplies of the gums used became of great importance. In 1851 such quantities of these raw materials were being used that the manufacturers began the establishment of the system of direct trade relations with the west of Africa.

The growing importance of both the paint and varnish production of the country had meanwhile early affected the oil-mills. Until 1836 these mills used only home-grown seed, and a capacity of fifty bushels a day was a very fair average output. Under the increasing use of linseed-oil new methods were found necessary, and the firm of J. & L. K. Bridge, of Brooklyn, in that year imported the first cargo of flaxseed from Sicily. Odessa, Alexandria, and, in 1846, Calcutta were successively opened as supply points of this rapidly increasing trade. It was during this transition period, also, that the use of machinery other than the old-fashioned screw, lever, and wedge was introduced by Thomas Rowe. To-day a good-sized oil-mill will easily produce from 5000 to 6000 gallons of oil per day—more than the mill of earlier days turned out in a year.

In 1850 the paint industry in this country entered upon a new era. The zinc deposits of New Jersey, opened in that year, gave an adequate and cheaply worked supply of ore from which the oxide could easily be reduced. This zinc oxide, in the form of a white powder, had been recognized since the last decade of the preceding century as a valuable substitute for white lead as a body for paints. It had up to this time, however, received little attention, owing to the restricted amount available for the market. The new and abundant supply turned the manufacturers to experiments in this direction, and its use since has been general. While of an inferior body and opacity to the better qualities of white lead, the zinc oxide was still a most excellent substitute, and in some respects it even excelled the former, particularly in point of decreased cost, and in being unaffected by many of the gases, such as sulphureted hydrogen, which blackened, by chemical reaction, the lead paints. Several mines were immediately opened, and the ore reduced and turned in a furnace, where resultant white and powdery zinc oxide floated upward, was caught in bags, pressed, and sold to the paint manufacturers. Mineral paints, too, made from different earths, came into prominence at about this time, much being claimed for their fire-proof and indestructible qualities.

Of the chemical and technical discoveries and appliances by which new colors, finer and more delicate shades, the bright and vitrifiable pigments of the decorative potter and art-tile manufacturer, and the paints of the artist, either in oil or water-color, have been produced it would be tedious to the general reader to speak. The art of mixing colors to produce the almost innumerable tints of to-day has developed with the increased volume and discriminating demand of the trade. The first paints ready for use were made in 1852 by my house. They were tinted colors in paste form. To-day almost every conceivable shade of color is found thus prepared in hermetically sealed cans, and each country grocery and cross-roads store has an assortment of paints, before which, even in New England, the green-shuttered white house is slowly retiring from the landscape.

About 1857, D. F. Tiemann & Company, who had succeeded Anthony Tiemann, made carmine from cochineal, a monopoly theretofore held by France. In 1860 they made a blue soluble in water for laundry use, and free from acid, that previously made having been a mixture of ordinary Prussian blue and oxalic acid. In 1860 they established, also, the manufacture of quicksilver vermilion, which had previously been monopolized by England.

The manufacture of oil and varnish meanwhile proceeded along the same lines and in response to causes similar to those affecting the paint industry. In all the earlier years of this century, and to some

extent even to-day, the use of these substances has been more or less influenced by the fact that lumber was cheap and abundant. To preserve wood at the expense of paint would have been indeed gilding the tinsel. Its use was therefore rather a luxury, a deference to the esthetic sense, than a necessity resulting in practical economy. Gradually it dawned upon men's minds that even if lumber were cheap, wood was not the only expense in construction, and the economy of preservation was seen. So, also, with varnish; and by the middle of the century both of these articles were being used for practical reasons as well as for purposes of decoration or ornamentation. By 1860 there were three varnish factories west of the Alleghanies, and many in the Eastern States, while its consumption was steadily increasing both at home and in the foreign trades. Since then its growth in importance and extent has been steady and rapid, and it is to-day a great factor in the industries of which this chapter treats.

These three allied manufactures have been, in common with the other industrial interests, subjected of late years to modification in methods and appliances. Of the three, the manufacture of varnish has, perhaps, been the one in which Americans have been the most successful in foreign markets. The recognition of the excellence of our product, following almost immediately upon the first exportation in 1836, has increased rather than diminished as time has gone on. To-day we export more than five times as much varnish as we import, the official figures for the year 1892 showing total exportations of $282,278, as against importations during the same time amounting to but $52,746. During the present year our shipments abroad have still further increased. The growth of home consumption has meanwhile continued so rapidly that in keeping pace with its demand the annual output has nearly doubled during each of the past three decades. The exact proportions of this industry since 1870, as given in the census reports, are as follows:

THE VARNISH INDUSTRY, 1870 TO 1890.

YEAR.	NO. ESTABLISHMENTS.	CAPITAL.	EMPLOYEES.	WAGES.	COST OF MATERIALS.	VALUE OF PRODUCT.
1870	59	$2,168,740	415	$252,059	$3,311,097	$4,991,405
1880	81	3,775,100	573	366,716	3,609,684	5,721,524
1890	140	.	1,351	1,745,061	7,825,663	13,795,310

The manufacture of varnish has remained, in the mean while, in the hands of separate large concerns, without consolidation or combination, although efforts have been made at various times to organize the trade.

The lead, paint, and oil interests of the country have, unlike the varnish manufacture, come during late years to certain centralizations of management, tending to greater uniformity and economy. In paints, of which lead still remains one of the most important components, this movement has resulted in the formation of the National Lead Company, which controls the greater part of the output of white lead in this country. In itself this company includes and operates its own oil and paint-grinding mills, as well as the lead factories proper, and with a capitalization of about $30,000,000 is the largest single interest in the paint business, although there are many great individual firms equally prominent relatively to their output. There is also a large interest concerned in the import branch of the paint and color trade, making a specialty of foreign earths, leads, and mixtures. The development of the manufacture is shown by the following figures:

THE PAINT INDUSTRY, 1870 TO 1890.

YEAR.	NO. ESTABLISHMENTS.	CAPITAL.	EMPLOYEES.	WAGES.	COST OF MATERIALS.	VALUE OF PRODUCT.
1870	143	$11,156,400	2,240	$1,567,037	$11,468,728	$16,922,475
1880	244	13,555,292	4,483	2,132,255	17,062,555	23,280,787
1890	382	...	8,737	3,605,620	24,930,532	42,438,171

The growth thus indicated in this industry during the thirty years given does not, however, represent the full increase in consumption for that time, owing to the fact that imports of paints and colors have always exceeded the exports. American colors are found in many foreign countries, and the trade is one that will grow. From a total exportation of only about $20,000 in 1835, the shipments sent abroad in 1892 amounted to $823,907, only about

$150,000 less than the imports of the same period. For the fiscal year of 1895 the exports were only $729,706, while the imports had swelled to a total of $1,246,924 for the paints, pigments, and colors, and $679,637 for clays and earths largely consumed in the production of paint.

Coincident with the development of the paint industry has been the improvement of methods. Mills of modern design and construction obviate much of the danger to the workmen arising from the poisonous nature of the substances used, notably white lead. While the basic principles, both in the manufacture of the staple leads and in the grinding of all paints in oil, remain practically unchanged as they have come down to us from remote times, there are many innovations which have increased the safety and facility of paint manufacture. New processes and radical departures are also being urged and even experimented with on a practical scale.

The manufacture of linseed-oil, formerly divided into numerous small interests, has likewise been largely consolidated by the formation of the National Linseed-Oil Company, which has a capital stock of $18,000,000, and controls the bulk of the product. The single cargo of flaxseed imported from Sicily sixty years ago has become a vast import trade in modern times, and during the present year, owing to the shortness of last year's home crop and the demand for Calcutta seed, its volume has increased to unprecedented proportions. In the first eight months, ending September 1st of the present calendar year, the importations of flaxseed reached the enormous amount of 2,772,718 bushels. Nevertheless the linseed-oil manufacturers have had much to contend against in the adulterated oils produced so largely of late years. Not only have inferior imitations become common, but the residual products, in the shape of oil-cake and meal, are being supplanted to a great extent by the cotton-seed cake and meal. That linseed-oil will ever be superseded, however, as the most reliable vehicle for paints and varnishes is extremely improbable. The census of 1890 gave the annual output of the sixty-two linseed-oil mills of the country at $23,534,306, in producing which 2073 employees earned $1,286,062.

Summed up briefly, the foregoing figures show that the industries of which I have just written have an aggregate annual production of $77,767,987, and distribute in wages to the workmen every year $8,640,749. These are the bare and unadorned figures, expressing neither the benefit nor the magnitude of the contributory branches, in the mining and grinding of earths and ores, the sums paid to the transportation companies of the country, the consumption of tins, the trade in brushes, and the opportunity for labor afforded to artisans and painters all over the country in the application of the product. When it is remembered that in 1795 we were utterly dependent upon foreign countries, I think I need say nothing further or more commendatory of the American paint, oil, and varnish trades.

One of the important features of the trade to-day is the Paint, Oil, and Varnish Club. Nearly every large city in the Union has an organization bearing that name, and so closely are they affiliated that they might be called one body. The idea originated in Boston, Mass., in 1867, but the first club was not formed until 1873. It was preceded in 1871 in the same city by the Boston Commercial Association, the membership of which was composed chiefly of paint and oil manufacturers, with Charles Richardson as president. The experience of the New England club in organized effort and coöperation attracted attention throughout the country, and on a similar basis other organizations have been formed. The clubs, since their formation, have been called upon to deal with many matters of importance to the trade, and in nearly all cases where misunderstandings or wrongs existed amicable adjustments have been made.

A great achievement of these clubs has been the formation and maintenance of credit bureaus, which have not only worked to the satisfaction of all the members, but have accomplished much good to the trade. The paint and oil merchants of New York City had for several years endeavored to organize a business association, but without success, until the Boston club of a social order came into existence. The formation of the New York club was due to the efforts of W. B. Templeton, the present secretary and treasurer. One of the most valuable features of the club is the membership of a subcommittee in the New York Board of Trade and Transportation. This committee was created in order that the trade might have substantial backing in case of particular legislation being required. The accomplishment of the coalition with the Board of Trade is regarded as an important step, as it gives the club strength and importance that it could gain in no other way. The organization of the Boston and New York clubs was closely followed by the formation of similar clubs in Philadelphia, Pittsburg, Chicago, Kansas City, New Orleans, and other cities.

Dan'l F. Tiemann

Albert F. Hayward.

CHAPTER XCV

THE CONFECTIONERY TRADE

THE early history of the confectionery business of this country is somewhat obscure, as little was published in relation to it until within the last fifty years. The term "confectionery" embraces a vast number of edibles or compounds that have sugar as a base or principal ingredient.

The art of manufacturing confections and sweet preparations was at first largely confined to apothecaries and physicians, who used sugar and honey to disguise their medicines; but in later years the making of confectionery became a separate and distinct branch of business, although the druggist is still dependent upon the manufacturing confectioner for an important line of his goods, known as medicated candies. Few modern industries have experienced more frequent or more radical changes during the last century than the confectionery business. Previous to the year 1851 the manufacture of "boiled sweets" was largely an English specialty, and its extension to other countries had its origin in the unique display of these goods made by the London confectioners at the first international exposition in that city in that year. The interest then attracted to the business gave it a new impulse and caused it to extend to Germany, as well as to France, which in the manufacture of chocolate bonbons and comfits excelled all other countries.

In the United States we find that as early as the year 1816 there were published the names of twenty confectioners in the city of Philadelphia who were manufacturing and selling candies. Among the pioneers in the business appear the names of Sebastian Henrion, who was succeeded by Henrion & Chauveau in the year 1844, and Sebastian Chauveau, who was the first to manufacture gum-drops, jujube paste, and marshmallows in this country. Another was Paul Lajas, who in 1831 changed his business from the manufacture of confectionery to that of sugar refining; George Miller in 1833, William N. Herring in 1834, S. S. Rennels in 1838, and J. J. Richardson. In the city of New York, among the old-time confectioners were Ridley & Company, established in 1806, R. L. Stuart in 1828, James Thompson, John Stryker, and Delmonico Brothers. In Boston, in 1816, the names of Arnold Copenhagen, Lawrence Nichols, and William Fenno occur; and in Baltimore, Joseph Bouvey, Augustus M. Price, and John L. Bridges were pioneers in the business before 1831.

Previous to the year 1845 the manufacture of confectionery was in a somewhat crude state. As a rule each confectioner made his own goods, his stock in trade being limited to the ordinary stick candies, sugar-plums, and molasses candy, while all fancy goods were imported from France and other foreign countries. The introduction of machinery in the manufacture of confectionery has added much to the development and increase of the business. The foreign manufacturers were using some machines in their factories, but very little had been done in the United States in this way until about the year 1845, when Sebastian Chauveau, of Philadelphia, imported the first revolving steam-pan used in the country; and in the year 1846 the first machine for making lozenges was invented and built in the city of Boston by Oliver R. Chase, who with his brother formed the firm of Chase & Company, and began the manufacture of lozenges as a special branch of business. In the year 1866 the first machine for making printed work or conversation lozenges was built and used by Daniel G. Chase, also of Boston.

Many improvements are constantly being made, and new and improved machinery has been invented that is adapted to the manufacture of the various kinds of goods, and to meet the constantly growing demands of the business, so that the manufacture of special machinery for confectioners' use has become a separate and important industry. Nothing can convey a more complete idea of the wonderful growth and increase of the industry in the United

States in the last half-century than the official census returns, as published at Washington from 1850 to 1890, with the following comparisons:

THE CONFECTIONERY INDUSTRY, 1850 TO 1890.

YEAR.	NO. OF ESTABLISHMENTS.	HANDS EMPLOYED.	CAPITAL INVESTED.	TOTAL WAGES PAID.	VALUE OF MATERIAL USED.	VALUE OF PRODUCT.
1850......	383	1,733	$1,035,551	$458,904	$1,691,824	$3,040,671
1860......	541	2,340	1,568,478	668,423	2,991,186	5,361,100
1870......	941	5,825	4,995,293	2,091,826	8,703,560	15,922,643
1880......	1,450	9,801	8,486,874	3,242,852	17,125,775	25,637,033
1890......	2,921	27,212	23,326,799	11,633,448	31,116,629	55,997,101

Imposing as these figures are, they are somewhat misleading as to the real growth and magnitude of the business. They take no account of the large amount in the aggregate that is produced by the small manufacturers in all sections of the country. They give only the result of production in the large manufactories, that are chiefly centered in the great cities. The great increase as noted between the years 1880 and 1890 shows a gain of more than 100 per cent. in value of production in the ten years, and it has been estimated by careful and conservative men in the trade that by the end of the present century the annual output of the large factories of the country will reach a total value of $100,000,000. In addition to the great increase of home production, the growth of the import trade has been an important factor. Previous to the year 1837 all confectionery that was imported was classed with sugars, but in that year the total importation as reported was 8386 pounds, valued at $912. In the ten years following that date the total of imports, as reported for the whole time, was only 12,000 pounds, at a value of $1400. From 1847 to 1857, 258,374 pounds were imported, valued at $34,447; from 1857 to 1867, 260,860 pounds, valued at $39,169; and from 1867 to 1877, 865,812 pounds, valued at $145,797. From 1877 to 1887 the total value of imports was $151,632; and in the eight years following, up to the present time, there has been a gain of more than 150 per cent., the total value being $387,152. The analysis of the returns shows that from the year 1837 up to 1849 the value of foreign confectionery imported in no year equaled that of 1837. But in subsequent years there was a gradual increase in the amount and value up to 1855, when the figures reached 74,371 pounds and $8949 in value. From that date there was an irregular falling off in the importations until 1865, when there were 35,388 pounds, valued at $4094. Following that period there was an irregular increase up to 1876, when the returns showed 87,955 pounds, valued at $18,500; and this increase continued in successive years until 1892, when confectionery to the value of $97,741 was received from foreign countries. This was the largest amount in any one year, the figures rapidly falling in the three following years, the amount in 1895 having dropped to $30,745. While the rapid increase and growth of our home market has made large demands upon the facilities of our manufacturers for their productions, the enterprise and push of the men who have been and are now engaged in the business has led them to reach out into other fields and larger markets.

The foundation of the American export trade in confectionery was laid in 1865, when goods to the value of $26,429 were exported. This was a good start, and with the exception of the following year, when none was shipped or the amount was overlooked, this branch of our foreign trade showed a fairly steady increase between that date and 1880, when the total export was valued at $81,757, the quantity in pounds not being given. Since then the United States has sent large amounts of confectionery to foreign countries every year, as shown by the following table, covering from 1881 to 1895, inclusive:

EXPORTS OF CONFECTIONERY, 1881 TO 1895.

YEAR.	AMOUNT.	YEAR.	AMOUNT.	YEAR.	AMOUNT.
1881..	$73,253	1886..	$98,570	1891..	$181,501
1882..	62,391	1887..	173,570	1892..	204,609
1883..	103,290	1888..	155,521	1893	334,607
1884..	112,046	1889..	151,685	1894..	491,748
1885..	88,549	1890..	179,276	1895..	712,552

From the above statistics it appears that while our home market has been constantly broadening and extending, and the consumption of the products of our factories has largely increased, the markets of the world are being opened to us. Our foreign trade is steadily enlarging, American confections meeting with much favor in all markets where they have been introduced.

Of the important factors that have largely contributed to the wonderful development and growth of this industry, more especially in the last thirty-five or forty years, may be mentioned the rapid growth and increase of our population during this period, the opening up of new territory, and the development of new industries that have resulted in bringing general prosperity to all classes of our citizens. The low price of sugars and other materials used in the manufacture of confectionery, together with the introduction of new and improved machinery in our factories, has made it possible to produce goods of superior quality at a comparatively low price, thus bringing them within the reach of the poor as well as the rich. There has been constant rivalry among our leading manufacturers to improve the quality of their productions.

The late Edward A. Heintz, of Philadelphia, who in the year 1874 established the "Confectioners' Journal," the pioneer trade paper in the interests of our business, and who through its columns constantly advocated progress and suggested improvements, thereby giving to the members of the trade a new impulse and inspiration, rendered incalculable service in popularizing the confectionery business among the people. The two great international expositions of Philadelphia and Chicago, where the fine display made by our manufacturers attracted the attention of the world, gave new importance to the industry and added much to the extension of the business. The organization of the National Confectioners' Association of the United States in the year 1884 was an important and prominent factor in this development. It was organized by and included in its membership all the leading manufacturers of the country, having for its declared purpose, as stated in its constitution, "to advance the standard of confectionery in all practicable ways, and absolutely to prevent hurtful adulterations; to promote the common business interests of its members, and to establish and maintain more intimate relations between them; to take united action upon all matters affecting the welfare of the trade at large."

The results of the work of this association are clearly manifest on every hand in the securing of necessary legislation in the different States whereby the manufacture or sale of any candy containing any harmful ingredients or poisonous colors is prohibited by law; by the effectual stamping out of adulterations in the manufacture of our goods, and by establishing in the minds of consumers a feeling of confidence in the purity of our productions.

The results of this combination of factors are shown in the investment of many millions of capital in this industry; in the building of large factories and warehouses for the transaction of its business; in the employment of many thousands of working-people in the manufacture of confectionery; in the enormous value of the annual product of all these establishments; and in the birth and successful growth of a competition in the United States against the markets of the world. Of the men who have been actively engaged in this development and growth of an important industry we may not speak in detail. Those who have honored their calling, men of sterling integrity and uprightness of character, men of courage, energy, and foresight, constantly pushing forward toward larger and better achievements than their predecessors, would make a long list of names. Their work is evidenced in the record that has been made of the growth and development of an industry which, though small in its beginnings, has in these latter days of the century become a business of such large proportions as to be entitled to rank with other important manufacturing and mercantile industries of our country.

A. T. Hayward

CHAPTER XCVI

THE FURNITURE TRADE

IT is a singular fact that we should now, after a century of commercial independence, return to the same modes and fashions in furniture which prevailed one hundred years ago; and although we adapt them to our present requirements, we cannot refrain from admiring even to-day the lines on which our forefathers built their chairs, tables, bedsteads, and other articles of furniture. Although we had become politically independent of England, she was to impress us for a long time to come with her literature and arts; so that the American furniture of that time differs but little from that of England, not, however, being so ornate. This furniture, known under the name of colonial, has frequently been exploited lately, and is too well known to need description. At that time, if we except those who possessed ample means, people had little furniture, and it was of the most simple character.

The early cabinet-shops were like the second-hand repair-shops to be seen to-day in New York, Boston, Philadelphia, and other large cities. A great many cabinet makers continued to use for years the patterns they had produced, and consequently made furniture until late in the century on simple Chippendale lines. It is impossible to state the amount of furniture made during this early period, but it must have been small when we consider that the population of this country was then only about 4,000,000 people. Gradually the Empire fashions, which were making themselves felt all over Europe, spread to America, and shapes became heavier and more pretentious, mahogany being used almost exclusively. Heads of animals were used, and claw-feet became a general feature. Common furniture was heavy and unattractive. The condition of things at this time was not particularly favorable to the development of art industries. Europe was a great battlefield, and even this country became involved in war with England.

Under these conditions little thought was given to the manufacture of furniture, and for some years there was a decline in this industry, which was considered of so little importance that no mention is made of it in the official records. Cabinet makers soon after changed their style, and began producing a debased rococo style, which did not have the elegance or character of the Louis XV., but was covered with a florid ornamentation in which the only consideration seems to have been that of display. The extravagance of curves and lavish ornamentation brought about a reaction, and toward 1830, following the fashion in England and France, an attempt was made to construct furniture in the Gothic style, but with very unsatisfactory results. The lack of artistic training of the manufacturers, who were, as a rule, cabinet makers or carvers by trade, made it very difficult for them to handle a method of decoration and construction so little appropriate in itself to the requirements of home comfort. This Gothic style of furniture, monumental in appearance, was made to a limited extent only, although its influence is to be noticed on other furniture placed on the market at this time and later. The making of rococo furniture was kept up by a large number of cabinet makers, the cheaper furniture being for many years made in this style. It was also during this period that steam, applied to cabinet-makers' machinery for the first time in 1815, occasioned a revolution in the manufacture of furniture, bringing labor-saving devices into more general use, and enabling the cabinet maker to supply the rapidly increasing demand for his product. In 1825, Mr. Richardson, of Philadelphia, introduced the circular saw, and Taylor, Rich & Company at this time erected the first mahogany-mill in America, a number of these saws being used there. Ordinary furniture, which until now had been very plain, was covered with endless scroll-work and moldings, pro-

George W. Gay.

duced so easily by the new machines. The manufacturers indulged for a time without restraint in this ornamentation.

The use of machinery in shops, and the increased facilities for transportation, wrought a wonderful improvement in the furniture trade; and the cabinet-shop, which had until this time been of small importance, making to order various kinds of furniture and kindred articles produced from wood, suddenly assumed large proportions, and confined itself to furniture only, using in the making of it the new devices which were constantly being brought forth by ingenious inventors. The value of the furniture product in the year 1850 may be estimated at about $15,000,000, and the industry gave employment to 37,000 people, out of a population of a little over 23,000,000.

For a long time a great number of hand-shops survived, making to order special high-grade work; and they succeeded in impressing their patrons with the idea of the inferiority of machine-made furniture, which at this early stage in the introduction of machinery was not entirely without foundation. The extensive use of machinery in shops had the immediate effect of again changing the style of furniture. Manufacturers looked for a fashion in which they could use their facilities to the best advantage, and at the same time retain the attractiveness of their earlier work. This they found in the Renaissance, which for a number of years superseded all other styles in the best class of furniture.

Up to this time the furniture industry had been confined to the Eastern States, principally in and around Boston; but a number of factories were now started in the West, which, situated as they were in proximity to large forests and regions where population and wealth were rapidly increasing, soon became important factors in the production of furniture in the United States. These factories, equipped with new machinery and using native timber, such as oak, ash, walnut, etc., produced at first a low grade of furniture in which art seems to have been but very little considered, the main object being to supply this prosperous population with the articles that their new conditions enabled them to buy. Those who wanted more artistic furniture purchased it from the East. The art revival which had taken place in Boston and New York was fostered by increased travel in Europe, where exhibitions were taking place at short intervals in London and Paris. Moreover, the consideration that old furniture was beginning to receive brought forcibly to the people the inferiority of that then made, and manufacturers gave more attention and study to its appearance than before. Trade kept increasing with the general wealth, and in 1860 the production reached $25,500,000; but the number of working-men employed in this industry, owing to the improvements in machinery, had fallen to 28,000. The population had then reached almost 31,500,000.

Industries in general were now to receive another blow, on account of the War of the Rebellion. As soon as this conflict was over, the extraordinary activity which had prevailed in military circles was transferred to the industrial field, and from this time on it is by leaps and bounds that improvements can be noted. The furniture trade was in the hands of two classes of manufacturers, one class of whom, having taken the place of the old hand-shop workers, made high-class work to order,—not only furniture, but interior woodwork and decoration as well,—continuing the old traditions, but now using machinery extensively. The other class of manufacturers studied the wants of the people, and produced suitable articles at prices which were within the reach of the masses. It is to them that we are indebted for the gigantic development of the industry, they having placed within the reach of all, strong, ornamental, and practical furniture. We have seen that men of taste had recognized for some time that our furniture was inferior to that made at the end of the last century, and had begun to study not only the styles of that period, but also those of the English and French prevailing in the past. As a result we find that a great variety of styles were employed in the productions of the leading firms, who were always striving for novel effects.

A work published in London, England, in 1868, entitled "Hints on Household Taste," by Mr. C. Eastlake, had a great influence on the purchasers and makers of American furniture at this time. This publication created unbounded enthusiasm in America as well as in England. It waged war on modern work, and advocated returning to the primitive principles of Gothic construction, more intelligently interpreted than in the first attempt; and gave positive instructions as to what was right or wrong, not only in the line of furniture, but in draperies, carpets, and other household decoration, as precisely as if the art had been a science. This book was looked upon as a sort of gospel treatise on furnishing, and however much we may at this time ridicule some of the ideas conveyed, it directed the public mind in its search for more artistic surroundings at home. From that time the other styles—rococo, Renaissance, etc.—were discarded, and de-

signs in accordance with the newly developed taste took their places. The movement in favor of more perfect construction and the use of straight lines exclusively became general, the stiff appearance being relieved by an abundant use of arches, spindles, turnings, etc. This style allowed the manufacturers to do the greater part of the work by machinery, for which it seemed specially adapted. The increased interest that the public took in furniture developed the trade in an unprecedented manner, the production for 1870 being $68,500,000, or two and one half times that for 1860. The number of men employed at this time shows a similar increase, being 55,800, out of a population of 38,500,000 people.

The financial depression of 1873 caused a reaction in the furniture industry, as it did in all other branches; but, without doing any more harm than to reduce the output for a time, it stimulated manufacturers in making better goods so as to meet the keener competition in trade. The Centennial Exhibition in Philadelphia in 1876 had a far-reaching influence, especially on Western manufacturers, who until this time had not had occasion to compare their products with those of the best manufacturers of America and Europe. This exhibition marks the highest point that the Eastlake or early English—whose most able exponent was the English architect and designer, Mr. B. J. Talbert—was to attain. A number of the most prominent manufacturers of this country had their exhibits made in this particular style. It was quickly taken up by the manufacturers of cheaper furniture, who until then had given very little attention to artistic form, and they are responsible for the enormous quantity of furniture of this description that can yet be seen in the auction-rooms of large cities, the only relation of which to the true Eastlake seems to be the quantity of spindles introduced in its construction. The strife for originality, which was soon to be one of the characteristics of Western manufacturers, had now begun to show itself; but an insufficient knowledge of art subjects rendered many of their designs more strange than beautiful, and more noticeably so when they were working on the lines of any given style; but through diligent efforts their designs were steadily improved, and this, in connection with their superior facilities, has secured to them a large part of the Eastern trade.

The volume of business showed a substantial increase during this decade,—1870 to 1880,—although not as large as during the preceding period. The value of the output of furniture for 1880 was $77,845,000—an increase of thirteen and five tenths per cent. in value, but a decrease from $1.77 to $1.55 per capita of the population.

The Eastlake style, based on foreign ideas, and little in keeping with our style of work, could not possibly get a lasting hold on the American people. It was accepted only as an improvement over previous styles. The wonderful changes which occurred in architecture, investing it for the first time in American history with a purely American spirit, could not fail to have a strong influence on furniture. Mr. H. H. Richardson, a man of extraordinary ability, after having brought out several original and striking architectural designs of classic excellence, won general admiration for his later works, in which he revived the beauty of the old Romanesque decoration, adapted to modern ideas and modern needs. A monument to his genius is Trinity Church, Boston, designed early in the seventies, and which attracted considerable attention by its radical departure from the generally accepted Gothic style of church architecture; but it was not until subsequently to 1880, after Mr. Richardson had used the Romanesque for private residences, and had himself designed a part of the furniture, that it became popular. Once started, however, its growth knew no bounds. In fact, in a few years everything was Romanesque or Byzantine,—houses, furniture, house decoration, jewels, etc.,—and it looked at one time as though it were eventually to become our national style. As much was claimed for it by eminent men. Furniture manufacturers eagerly welcomed this departure, for the ceaseless demand for new things, as strong then as it is now, obliged them to change their patterns very frequently. Unfortunately, by passing through the hands of manufacturers of cheap furniture, it lost all of its original beauty. There is a delicacy required in the Romanesque carving which cannot be produced cheaply; and the universal use of the pointed acanthus leaf as the only type of decoration soon became monotonous, and, under the enormous production of inferior goods, the public lost the interest which the work of eminent artists had succeeded in creating.

During this decade great improvements were made in woodworking machinery, and a large number of new devices were invented. Among them, and probably the most important, was the carving-machine, which enabled manufacturers to ornament even the cheapest kind of furniture, sometimes to excess; and although this machine is not yet perfected, it has reached a high state of usefulness. The amount of business done in 1890, large as it was, did not keep up with the increase of population,

and the present depression, which has been by many attributed to over-production, is certainly the result of lessened consumption as well. The value of the product in 1890 was $86,362,685, an increase of eleven per cent. over that of 1880; but the amount per capita of population dropped to $1.38, as compared with $1.55 in 1880, and $1.77 in 1870. No doubt the facilities for the production of furniture are such that even should the home consumption reach the level of 1870 it would not be sufficient to absorb the possible output of our manufacturing institutions.

The International Paris Exposition of 1889, where the French cabinet makers showed a great quantity of eighteenth-century furniture, especially of the Louis XV. style, generally beautifully designed and of excellent workmanship, revived a taste for the costumes and furniture of that period which spread rapidly to other countries, and was quickly followed by the people of the United States. In spite of the seeming difficulty of making such work by machinery, our manufacturers made, and are making to-day, a great quantity of furniture in that dainty mode, which certainly equals that of the same class made in Europe, and is generally better constructed. At this same time the style of the First Empire, which had been largely used in the higher classes of ordered work and decoration, was receiving some attention, but without such brilliant success as had attended the Louis XV.; the chasing and gilding of the brass ornamentation being too expensive for most of the manufacturers, and lacquered castings were used instead, which, a short time after being made, assumed a faded appearance, that lost for this furniture the public favor.

All the eighteenth-century styles, French or English, have been used by our manufacturers—Louis XV., Chippendale, Louis XVI., Sheraton, Hepplewhite, Empire, and also the Flemish Renaissance, so well suited for oak work, with its bold carvings and heavy turnings. So far all the efforts of manufacturers and designers have not succeeded in evolving a style of our own epoch, and we will probably continue to use for some time to come the ideas of the past, and more particularly those designs which were used in this country in the latter part of the last century, which, in addition to their beautiful simplicity, always appeal to the heart of an American. At the Chicago World's Fair, although the furniture trade had a very creditable exhibit, the public could not fully realize its importance, as, unfortunately, a large proportion of manufacturers did not display samples of their goods; and it is all the more to be deplored that among these retiring ones were some of the most important of the furniture manufacturers of the United States. But the furniture exhibited can be taken as a fair sample of the products of our factories, very little having been made especially for this display. The greater part of the work exhibited was taken from the regular stock of the various manufacturers, and compared favorably with the product of other countries.

Many of the numerous articles of furniture manufactured are distinctively American. The bureau, the rocking-chair, the folding-bed, the chiffonnier as now made with toilet, and in general most of the combination pieces of furniture made with a view of economizing space in apartments in large cities, are of this class.

The American bureau is a combination of the old chest of drawers and the dressing-table, having the drawer-room of the one and the swinging mirror and table-top of the other. This has been imitated in Europe to a limited extent, in the production of what is known as the English dressing-table. As made in this country, the bureau is one of the most practical pieces of furniture used.

The rocking-chair, almost entirely unknown in Europe, is found in every home in this country, yet it is difficult to ascertain when it was first put in use. We do not find any mention of it in the descriptions of articles of furniture in the last century. The first patent issued for improvements in rocking-chairs is dated as far back as 1830.

The folding-bed, in the shape of a sofa, with a box-seat for bedding, has been used in Europe for over a hundred years, but America can claim the folding-bed in other forms, such as the wardrobe, the cabinet, the mantel, and the combination; some of these were made as early as 1847. The demand for folding-beds, which reached its climax a few years since, is now showing a material decline.

The woods used in the manufacture of furniture are varied, and subject to frequent changes. Early in the century, mahogany, maple, and black walnut were in favor; then cherry and ash became fashionable; toward 1880, oak, so long forgotten, took a prominent place. At the present time black walnut is almost entirely out of use. Oak has kept its popularity for the hall, the library, and the dining-room. Mahogany, curly birch, and maple are still extensively used; all of them for the bedroom, and mahogany for the dining-room and the drawing-room in the better grades of furniture.

The changes in furniture coverings have been more frequent and radical than those in the woods. Haircloth and other coverings in use thirty years

ago have been superseded by materials more varied in texture and coloring. Their variety is almost endless, and they show, perhaps as much as anything else, the advance that art as applied to furniture has made in this country.

The present centers of the furniture industry are, with one exception, the largest cities, which, with their densely populated suburbs and surroundings, offer large markets. Of the cities whose productions amount to more than $4,000,000 per annum, I find as follows:

FURNITURE PRODUCTION.

New York	$15,661,491
Chicago	14,764,435
Philadelphia	8,288,333
Grand Rapids	5,688,240
Boston	5,455,389
Cincinnati	5,339,394
St. Louis	4,461,546

Grand Rapids, a city of less than 100,000 population, occupies a unique position as a furniture-producing center, in that the principal buyers of the country visit this market twice a year, in January and July, and this has become so general that manufacturers from the larger producing centers have their samples here at the regular trade sales. A celebrated writer, in describing this industry in Grand Rapids, refers to "furniture of the sort that proclaims Grand Rapids the mother of art and comfort."

The furniture industry of the United States has to-day reached a magnitude unknown elsewhere, and the perfect equipment and organization of our mammoth factories, capable of an enormous production, make it imperative that some outlet should be found for it outside of the home demand. Intelligent efforts are now being made in this direction by a number of manufacturers, principally from the West, and there is every prospect of our being able eventually to secure a large foreign trade for our American product.

Geo. W. Gay

CHAPTER XCVII

THE HARDWARE TRADE

HARDWARE is essentially a business that belongs to a new section of country. It has been pertinently said by the pioneer, going into a new and unsettled district, that the first thing he wants is "grub," and simultaneously with that, something in the hardware line with which to cut and cook it. Following this line of thought, it can readily be seen that the larger distributing centers for the hardware business would naturally be in the central-western country, where for the past twenty years the United States has been so rapidly growing. In the eastern part of our country, on the contrary, the necessity has been for improvement and enlargement rather than for pioneer development. At the present time it is safe to say that there are larger distributers of hardware (jobbers) in the cities of Chicago and St. Louis than anywhere else in the world.

There is no other branch of manufacturing in this country which is so distinctly American as hardware; that is to say, there is no other line upon which the peculiar Yankee ingenuity so distinctly impresses itself; no other line that is so entirely free from imitation of the ideas of the Old World; no other line that has so quickly asserted its claim to its own birthright and turned the universal import trade into a great and constantly increasing export business.

All this has been done within the brief period of the last half-century. Prior to that, the American hardware trade was but in its swaddling-clothes, struggling against the flood of cheap and ill-constructed foreign goods, but with victory already in its grasp; for, with far-seeing ken, it had been founded on broad and deep principles of success. Knowing well the temper of the people, it lay awake at night inventing and scheming for better and more economical methods, while the slow-going makers of the Old World were content with the ways that their grandfathers knew.

Hardware is very comprehensive, for, at the present time, it embraces almost everything that is not, strictly speaking, assignable to any other specific line of trade. At the beginning of this century it meant chiefly mechanics' tools and builders' hardware, whereas at this time it includes so vast a variety of goods as to make it difficult to enumerate them correctly. Comprising, as it does, almost all the small articles made of metal that are patented and used in the construction of houses or for household purposes, as well as tools for all classes of mechanics or professional men, it simplifies farm labor and economizes the time of the housewife; it covers all that could be classed as house-furnishing goods for kitchen and dining-room service, the product of the tin-shop and of stamped-ware manufactories, as well as tin-plate, sheet-iron, barbed wire, etc., and has within its range sporting goods, such as guns, rifles, pistols, ammunition, base-ball supplies — in fact, goods for all kinds of outdoor sports, not least among which are found bicycles. An idea of its vast range is conveyed by the fact that one hardware house in this country alone has in its catalogue about 45,000 kinds and sizes of articles, all of which it carries regularly in stock.

Before the first commercial treaty with England, in 1795, all of our supplies in this line, substantially speaking, came from England and Germany. Emigrants could frequently be seen bringing with them their hoes, rakes, and forks, upon which were strung their bundles of clothing. Later the German goods made great gain over the English. As will be seen by a more specific reference later on in this article, these goods were, as a rule, very crude, poorly made, and not at all to be compared with the articles that were manufactured even at first in this country.

The genesis of hardware in the United States was undoubtedly in Connecticut, where the village blacksmith was the manufacturer of such goods (chiefly implements and tools) as were wanted, which he fashioned to order as best he could. A very important individual was this same village blacksmith.

He was, so to speak, an autocrat in the community; without him it was impossible to obtain the necessary implements for the cultivation of the soil.

But little progress was made in this line of manufacture until the last half-century, so slowly did this industry take root in America. In 1850 the manufacture of hardware, speaking generally, was commenced in the United States. Until that time it is safe to say that an exceedingly large percentage—say, perhaps, four fifths of all that was used in this country—was imported from England and Germany. The goods were still practically the same crude and rough products they were a hundred years ago. No change worth noting had been made in the method of manufacture of these goods in Germany.

At the present time this country excels the rest of the world immeasurably in the manner and method of putting up hardware, as well as in the superiority of the goods in style, finish, quality, temper, and durability. Who that was in business during the decade of 1850–60 cannot remember the Spear and Jackson hand-saw, made in Sheffield, England, the then recognized only good saw in the world; and the stiff English paper in which these goods were wrapped, three of them constituting a shipping package; and what an ungainly seeming bundle it made after one had been taken out, leaving the remaining two to be done up as best they could in this unmanageable paper? Who can forget the old, and at that time the only good, horse-nail, "Griffin," with the letter G stamped upon the head of each nail, which came to us in twenty-five pound sacks, with almost as many points sticking through the bags to lacerate our hands as there were nails in the package? And who fails to recall the Butchers' file, which came in paper bundles, three dozen in a package, with the sharp point of every file peeping out of its cover, as if trying to see what America looked like?

Small goods, such as padlocks, door-locks, screw-drivers, scissors, rules, etc., were all put up in rough but strong English paper, which, while substantial, was very clumsy and inconvenient. All these goods, and many more, have long since ceased to be imported, and are made in this country of a quality so superior to foreign manufacture as to leave no room for comparison. It must be borne in mind, however, even at the risk of repetition, that the manufacturers of this country particularly excel in their method of packing and putting up for the convenience of the retailer. Files we put in half-dozen or dozen wooden boxes, with dovetail corners and slide-lids—an immense convenience to the retailer. Hand-saws come in compact pasteboard boxes (four in a package), and the box looks as well on the customer's shelf when partly empty, or entirely so, as when filled.

Horse-nails in wooden boxes have long since superseded the bag or sack of the English maker; and all small goods, even such commonplace and cheap articles as screws and tacks, are put up in boxes of most convenient form and shape for the small dealer, yet preserving—in fact, enhancing—the neatness of their appearance on the shelves.

The makers of American hardware seem to have had one central idea at all times; that is, to produce the best, most suitable, most economical, and handsomest articles that could be manufactured, and then to incase them in the best possible package. If it was an edge-tool, it avoided the clumsiness and overweight of the English on the one hand, and the homeliness and poor quality of the German on the other; if a measuring-tool, it exceeded even the French product in accuracy and beauty; if a file, it was produced by machinery, insuring absolute regularity and evenness of cut, and produced at a cost, perhaps, of one half of the foreign hand-made file.

All this time the introduction of labor-saving machinery was continued, so that the foreign article could compete with ours neither in price nor in quality. It has come to pass that our imports of hardware have almost entirely ceased, although there is yet some cutlery imported, and each year our export business in hardware shows a considerable and substantial gain. As will be noted in the detailed items which follow, we send our hardware all over the world; and in London, and even Sheffield itself, the birthplace of mechanical ingenuity, our American edge-tools are advertised as special attractions.

Figures convey but a faint idea of the magnitude and extent of the business, but it will be interesting to the readers of this article to know that one wire-nail factory in this country has a capacity of 1,000,000 kegs per annum; and that one horseshoe manufacturer, employing 2000 men, has an output of 750,000 kegs of horseshoes yearly.

There are enough screws and tacks made in this country, or at least there is a sufficient manufacturing plant to produce enough, to supply all the world and have a large quantity left over to be gathered up, like the loaves and fishes.

The experience of the last few years has thoroughly demonstrated the fact that the hardware business and its kindred lines is the pulse of the country's prosperity or depression; for so closely is it allied with the iron-producing interests, as also with the railway interests, that it shows more quickly

than any other branch the first approach of storm, and recovers sooner from the effects of it. When the hardware business prospers, so is the whole country prospering; when it is depressed, so also is every other line. Hardware is essentially a business based on utility and necessity, and as it comprises goods that are not luxuries, they seldom go out of fashion; although in one of its branches—builders' hardware—patterns and designs are often quickly superseded by something more modern, which drives out the first product by reason of the superiority of the improvement.

It is a fact worthy of attention that of all the goods that are sold by the hardware jobbers of the United States to-day fully thirty-five per cent. have been made or originated within the past fifteen years, so rapid has been the development of this business within the last quarter of a century. The difficulty of giving space, in detail, to the varied items of hardware can be realized in some slight degree from the statement that one single jobbing hardware house in this country purchases goods from about 3000 manufacturers, both foreign and domestic, although the number of foreign manufacturers from whom purchases are made does not amount to three per cent. of the sum total. No article upon hardware, however, would be complete without specific mention of a few of the leading items.

In the item of door-locks, latches, padlocks, and small builders' hardware, Americans have been particularly successful. In point of fact, their goods possess so many advantages over those made abroad as to defy comparison. In England, France, and Germany, they are still using a large, weighty wrought-iron door-lock, with its heavy brass key eight or ten inches long, clumsy and awkward; while in America that class of goods has long since been superseded by a smaller, more compact, and handsomer lock, with a small, flat steel key not more than an inch and a half in length, and easily carried in the waistcoat pocket.

Door-lock manufacture was first begun in Connecticut. Authorities differ as to just where it originated, some claiming the honor for New Haven and others for New Britain. From the best information obtainable it appears that this industry was begun in both these places at about the same time—1834. The first goods manufactured were the cheaper grades, chiefly plate and wood stock locks; and later English patterns in wrought-iron were copied. Very soon thereafter, and not later than 1840, door-locks were made successfully from cast-iron, and these immediately supplanted the old and clumsy wrought-iron locks, which have since that day almost entirely passed out of use in the United States. There is no article in the hardware business which so distinctly bears the impress of American originality, Yankee ingenuity, and New World progressive ideas as door-locks. Foreign locks and hardware are in each country the outgrowth of its civilization and the characteristics of its people. They differ markedly in each case. European peoples are conservative in their tastes, and changes occur very slowly. The influence of this characteristic is adverse to the development of inventors, and operates to discourage the few who appear by making their work unappreciated and unprofitable. The conditions in the United States are the reverse of this, invention being encouraged and rewarded, with consequent stimulation to fresh endeavor. As a result, the art of using cast-iron freely and effectively in light forms, so well known in this country, has never been acquired in Europe, and a prejudice in favor of wrought-metal exists there, which condemns, unheard and without trial, many American products because they are made of cast-iron, although the latter is often better adapted than the former to the intended use. These conditions have always stood in the way of the introduction of American hardware into Europe, but this prejudice is gradually melting under the absolute merit of the goods made by American manufacturers. American locks have been sold all over Europe for many years, but the trade in them grows slowly and is limited to the wealthier classes, and more especially those who by travel here, or by contact with Americans, have become imbued with the American spirit of progress.

American builders' hardware has in recent years been lifted to a new and higher plane in both design and execution. Formerly each new article was originated by the pattern maker or the lock maker, working with sheet-metal and file. Now, in one or more establishments, and perhaps in a number, the work of designing and originating proceeds in the same manner as similar work relating to the designing of machinery, steam-engines, or other mechanical and engineering productions, viz., by skilled draftsmen and designers working at the drawing-board, guided by the best obtainable skill and knowledge, and assisted by the fullest record of experience and data pertaining to the art. There is no reasonable doubt that a very large export trade in door-locks and builders' hardware generally will be had in the near future, because the merit of the American goods has been more thoroughly appreciated within the past two or three years than at any other time

in the past century. There are fifteen manufacturers engaged in making door-locks and builders' hardware in this country, with a capital of perhaps $25,000,000, employing 20,000 people, with an annual product of over $20,000,000. An item of interest is the fact that there are melted for use in the manufacture of these goods annually over 100,000 tons of metal.

There is probably nothing in the hardware line in which the American dealer takes more pride than saws, and especially hand-saws and such other small saws as are used by the carpenter and cabinet maker. It is believed that the first saws of any kind manufactured in the United States were made by William Rowland, in the year 1806, in Philadelphia. In 1823 a small plant was started by Aaron Nichols in the same place. In 1828 or 1829, in New York City, the firm of R. Hoe & Co. began to make circular saws from English steel, which were about the first manufactured in this country. In 1835 Noah Worrall started in New York City the manufacture of small circular saws. The following year (1836) William & Charles Johnson commenced the manufacture of saws in Philadelphia; and it was with this firm that Henry Disston, who afterward achieved a world-wide reputation for his wonderful success, learned his trade. In 1840 the firm of William & Charles Johnson failed, and Henry Disston accepted from them some tools, steel, and such material as he could get in the saw line, on account of wages that were due him, and with these he began to manufacture saws in his own name. After this there were several small industries started—by Jonathan Paul in 1840, J. Bringhaust in 1842, James Turner in 1843, and Walter Cresson in 1845. These four were each in turn bought out by Henry Disston. William Andrews was one of the first saw makers in this country, and his nephew still possesses the anvil brought here by his uncle in 1819. This is said to be the first saw-anvil used in this country.

Prior to 1863 all of the steel used in this country in the manufacture of saws was brought from England. In that year Henry Disston built and operated the first crucible-steel melting plant for saw-steel in the United States. He also built a rolling-mill, and from that time on used nothing but steel of his own production. It was a long and hard struggle for Henry Disston to secure recognition and command trade for his American-made goods, but how well he succeeded is known to all Americans. Up to this time the American market was supplied almost entirely by English manufacturers; but the growth and development of this business in the United States since have been phenomenal, and for many years past there have been, practically speaking, no saws imported into this country, while, on the other hand, the American-made goods are exported largely to every civilized nation on the face of the globe. But little or no advances were made in the manufacture of hand-saws before the time of Henry Disston, so that practically all the improvements in quality, style, methods of manufacture, etc., were made by him and his successors since the year 1865, and to them is due the credit of placing American saws in their present position, at the head of the "market of the world" for quality, finish, and correctness of pattern. The American manufacturers, having improved on the old patterns from time to time, aiming to make each as perfect as possible and distinctly suited to the particular class of work for which it was intended, have entirely passed the foreign maker, who is still producing the old clumsy style, with inferior finish, with none or scant improvements over the goods turned out a hundred years ago. It is safe to say that there is no other manufacturing concern in the hardware line in the United States that reflects more credit upon American genius, skill, ingenuity, and enterprise than that of Henry Disston & Sons, whose works are located at Tacony, a suburb of Philadelphia.

There are about 2700 persons employed in this industry, with an annual product of about $5,000,000; and there is nothing made in this country that advertises the United States better, more substantially, more practically, or more permanently than American hand-saws, so excellent is their quality, and so beautiful are their design and finish. There are consumed annually in the factory of Henry Disston & Sons 12,000 tons of steel, all of it used in their various productions. They make an average of 2500 dozen hand-saws each week in the year, every one of which is a practical illustration of the superiority of the American manufacturer. The capital invested in the manufacture of saws in the United States is $7,000,000 to $8,000,000.

The item of small farming-tools, such as forks, hoes, and rakes, is one of the exceedingly interesting manufactures in the hardware line, because, as has been stated, they were one century ago being brought here literally on the backs of the emigrants, and from them were suspended their bundles of clothing and household goods. Immediately thereafter the village blacksmith began to make them, forging the goods by hand in his crude attempt to copy those that were brought over by the emigrants.

Edward C. Simmons.

Iron was the sole material used (except the handles, which, of course, were wood). The goods were very clumsy, unshapely, awkward to use, and heavy. In the decade of 1820–30 the introduction of the trip-hammer revolutionized the entire business and made possible the production of goods by machinery. At the present time there are probably twenty-five different manufacturing works in the United States engaged on these goods, which are commonly called "hand agricultural tools," employing perhaps 1500 people, with a capital of $1,500,000, and an annual product of over $2,000,000. The steel consumed in these productions is more than 4000 tons annually. Of this product of $2,000,000, at least $250,000, and perhaps twice as much, is exported to foreign countries, leaving about $1,500,000 for home consumption.

It is a thoroughly well-recognized fact all over the world that American forks, hoes, and rakes are greatly superior to those made in foreign countries, chiefly because of their lightness and great strength, as well as their marked superiority of finish. In this one single class of goods foreigners have improved in their quality by reason of our competition—a condition that does not exist in any other line of hardware. These goods are exported to England, France, Italy, Switzerland, Germany, Austria, Norway, and Sweden, and the demand for them in those countries is steadily growing.

The cutlery business of the United States has an interesting history. While the American manufacturer of table cutlery has to a large extent—in fact, almost wholly—driven out the foreign goods, by reason of the excellence of quality and the economy of manufacture, the pocket-cutlery makers have not been so successful. However, they are to-day making a very considerable proportion of the goods that are consumed in the United States, and the goods they manufacture are fully the equal of anything made abroad. But when it is remembered that the cost of making pocket-knives is eighty-five per cent. labor and fifteen per cent. material, it can be seen how difficult it is for the manufacturer of pocket-knives in this country to compete with the cheap labor of England and Germany, and that he must rely greatly upon their excellence of quality, their beauty of design, and their taste in finish. The origin of pocket-knives in this country is traced back to the State of Connecticut, as is so much in the hardware line, beginning in the year 1842. The first factory was quickly followed by the establishment of five others in the same State. The result of this was that many of the best English operatives from the works in Sheffield came here, because they could find steady employment and higher wages than they had previously known. After a while some of these operatives combined their experience and savings, and formed a new company in the village of Walden, N. Y., on the coöperative plan, which is to-day the largest concern of the kind in the United States. The pocket-knife industry of this country is unquestionably in New York and Connecticut. Of fifty-five ventures since 1844 more than thirty-two have experienced failure, owing chiefly to their short-sighted policy of making goods for price rather than for merit—attempting to compete with the cheap labor of the old country in price rather than in the excellence of quality and finish. The successful ones (as is always the case) have been the long-headed business men, following the time-honored principle that "the best is always the cheapest." A large majority of these pocket-knife manufactories have been founded on the coöperative plan, locating in small villages where cheap water-power was abundant. To-day the investments represent about $1,800,000, with the employment of about 2000 persons. During prosperous times the consumption of pocket cutlery in the United States is in the neighborhood of 1,200,000 dozen per annum, representing perhaps $3,000,000. The larger part of this is imported from Germany and England, in the proportion of two to one in favor of Germany. Prior to 1850 the American market was supplied almost entirely from England, but the cheaper German grades are gradually driving out the higher-priced English goods. The home-made product has steadily improved in quality, and while it is not always as absolutely uniform as the English product, yet the best American knives are not surpassed by anything produced in Sheffield, and are far superior to the German in quality, temper, and finish. The genius of American manufacturers is much handicapped in one respect, by the impossibility, so far, of employing any labor-saving machinery worth mentioning, since the quality of the knife depends entirely upon the skill in manipulation and tempering of the mechanic. Although there is no export business in pocket cutlery, the manufacturers, at times, have given evidence of what they can do in the line of cheapness. Recently a single-blade knife with a wood handle, all handsomely finished, of a quality of steel which would take a razor edge, was produced by the manufacturers so cheaply that after the jobber and retailer had each had his profit it passed into the hands of the consumer for ten cents. I do not recall in all my business experience where an article

of so much value was given for so little money. Let me put it more plainly and emphasize it. I think this ten-cent knife is the cheapest thing I have ever seen, quality and usefulness considered. And bear in mind it is made in the United States. The complexity of the business may be gathered from the statement that in the manufacture of pocket-knives it is necessary to import mother-of-pearl from the Philippine Islands, tortoise-shell from the Indies, stag-horn from the parks and forests of Germany and India, ebony from the spicy isle of Ceylon and from Madagascar, cocoa-wood from unhappy Cuba, and rosewood from South America. Those of us who can recall our boyhood experiences when the village blacksmith was the recognized cutlery maker can well marvel at the enormous output, the amount of capital to-day invested in this branch of cutlery, and the exceedingly low prices at which these goods are sold.

Table cutlery was first manufactured in this country in 1832, before which period everything in this line came from England. Within thirty years thereafter, or say by 1865, the business was pretty much in the hands of the home manufacturers, and has been drifting steadily that way ever since, so that in the year 1893 the entire amount of foreign table cutlery imported into the United States was only $195,000, and there was not five per cent. of the consumption of this country exported. The table cutlery made in the United States, and especially the medium-grade article, far excels in beauty, finish, and design all foreign goods. Attempts have been made by foreigners to copy American patterns of table cutlery, but in no instance were they successful in producing so good an article, and the effort was finally abandoned. The State of Maine was probably the birthplace and cradle of the manufacture of table cutlery, the first effort being made at Saccarappa. In the "market of the world" there is no such great middle class as there is in the United States, and for that reason there is specifically a demand for medium-grade, well-finished goods in this country which does not exist in others, and which makes it possible to manufacture more largely of this class of table cutlery here than elsewhere. The amount of table cutlery exported is a mere trifle—probably not more than five per cent. of the product of the country. The estimated value of the production of the various table-cutlery manufactories of this country is $3,000,000.

American shear makers have set the pace for the world in that line of goods. They were the first to solve the problem of welding a high-grade steel blade to an iron backing or soft casting made to fit the hand. This was the invention of Seth Boyden in 1826. The manufacture of shears in this country was started in a crude way the year before, at Elizabethport, N. J. Welding by hand was carried on from that date until early in the sixties, when a drop-hammer was constructed by Mr. H. Wendt, the ram of which was raised by the friction of a rope pulled by hand around a revolving wheel or pulley. This rope later gave way to a flat leather strap, and was afterward succeeded by power drop-hammers operated by friction-rolls upon a flat board, under perfect control by the foot of the operator, the hands being free for the proper manipulation of the work. Our American shears are far superior to those made in foreign countries, and are exported in great quantities, especially to England, South America, and Australia. None of the foreign countries has adopted our method of manufacturing shears, and for that reason their goods do not compare with the American product. There are eight manufacturers engaged in this business in this country; total capital about $750,000, employing about 1000 people, with a product of about $1,500,000.

In the manufacture of fine mechanics' tools, such as are used by the higher class of machinists, the United States is the peer of any country. To-day one of the foremost concerns in this line, located in Providence, R. I., sends its tools to England, France, and Germany, where they are called for and given preference because of their great accuracy and almost infallible uniformity of manufacture. An illustration of the esteem in which they are held is shown in the fact that these American tools are used in the manufacture of the new French rifle which is attracting so much attention. Some idea of the exactness of such work may be gathered from the statement that in the production of fine firearms it is necessary that thousands of parts should be interchangeable, and should not vary by the thousandth part of an inch. Some of the micrometer calipers from these works will measure the two-hundred-and-fifty-thousandth part of an inch with accuracy; and this same firm, the Brown & Sharpe Manufacturing Company, have in their office a tool whereby the difference in diameter between two steel bars of the ten-thousandth part of an inch is made perceptible to both the eye and the touch. In the face of such excellence as this, is it any wonder that the export business in this class of goods should be growing rapidly?

The manufacture of wire cloth, such as is used for window and door protection, to keep out mosquitos,

flies, insects, and similar pests, has become a large industry in this country, although its beginnings date back only about twenty-five years, at which time the price was ten cents per square foot, and it was all made by hand-looms in a small way. It was first introduced into this country from Germany in the year 1870, and it cost at that time to import it from ten to twelve cents per square foot. In 1873 an improved hand-loom was operated in Cortlandt, N. Y., made by Mr. Wickwire; and in 1874 he invented and patented a shuttle motion known as the positive motion, the shuttle being carried through the cloth instead of being thrown, as was the case in former manufacture. With this principle to work upon he succeeded in making a power-loom in 1876, which was the first power-loom to make a hard-drawn wire cloth. This principle is now used by all manufacturers of wire cloth. The present price is less than one and one half cents per square foot, which is only a small fraction of the price of twenty-five years ago. In 1876 the consumption in this country was about 10,000,000 square feet. At the present time it is about 125,000,000. There is a total capital of about $3,500,000 invested in the manufacture of wire cloth in this country, consuming about 6000 tons of steel. The export trade in wire cloth is chiefly with Canada, Nova Scotia, South America, Mexico, and the West Indies, and, although light at present, is growing steadily. The American product far excels that of foreign manufactories in quality. There is no country that uses screen-cloth in windows and doors so generally as does the United States, because there is no country that approaches the magnitude of manufacture that we do.

The manufacture of files in this country was begun half a century ago in Providence, R. I. The product at first was entirely hand-cut, with the old-fashioned hammer and chisel; for although machines were invented at an early date, they were not used until about 1858. These first machines, however, were not successful, and it was not until 1865 that machine-made files can be said to have been fairly under way. The first year's output was only about 90,000 dozen, whereas now it is something like 2,500,000 dozen, aggregating over 5000 tons in weight. Up to 1870 the importation of files from England and from Switzerland was very large; but in that year imports began to fall off rapidly, and have now practically ceased, with the exception of a few fine Swiss files which are still brought over for special purposes. On the other hand, the exports are steadily growing, American files now being used in China, Japan, India, Africa, in many of the European centers, and in Great Britain itself. The merits of the American files are so pronounced, both as to wearing qualities, handsome appearance, and cheapness of price, that the preference is given them over files made in other countries. The manufacture is extremely intricate and involves the most careful inspection, and the marvel is that so few imperfect files manage finally to come through. It is a well-recognized fact in this country that machine-made files are more evenly cut than hand-made files can possibly be; and as nearly all the foreign files are still made by hand, the American product has a great advantage. In addition to this, Americans put up their files in very much better, more convenient, and more attractive packages than does any manufacturer in foreign countries. This particularly appeals to the trade of Australia, South America, and the West Indies. A very large percentage of the files manufactured in the United States is made by the Nicholson File Company of Providence, R. I., and Henry Disston & Sons of Philadelphia, in the various factories which they own or control. There are 148 file manufacturers in this country, employing 2400 people. The estimated capital invested is $3,000,000, and the total value of the annual product about $3,200,000.

The name of wood-screws recalls the somewhat familiar, time-honored joke of the would-be legislator who was one of the committee to revise the tariff, and who visited New England to consult the manufacturers of wood-screws. He was a native of the wild and woolly West, and saw no reason why New England manufacturers needed a tariff on wood-screws, for, according to his observation, the raw material, in the shape of growing trees, was abundantly cheap all through the New England States. There seems to be good evidence, as in the case of many other apparently modern inventions, that the gimlet-pointed screw was made as far back as 1755. The first application of machinery on record for making screws was in France in 1569. The first English patent was obtained in 1760. From 1846 to 1849 came the inventions of Thomas J. Sloan, and these, in connection with the inventions of Mr. Harvey, form the basis of the screw-machinery of to-day. Screw-machinery was in operation in this country in 1810 in threading wood-screws, and was known as French machinery, having originated in eastern France. Some of it was in use as far back as 1798 in New York State. In 1835 came the invention of machines for heading, nicking, and shaving screws, and in 1842 the

very important invention of the automatic feed for supplying blanks to screw threading and shaving machines.

One of the earliest manufactories in this country was established in 1838, with a capital of only $20,000. About 1841 the first American gimlet-pointed screws were placed on the market. Since that time screw-machinery of this character has been exported to England, France, Germany, Russia, Austria, and Italy. At present there are twenty screw-manufacturing concerns in this country, employing many thousand men, and with many millions of dollars' capital invested, as the business is very complicated, requiring large capital and delicately organized machinery. The machinery itself is among the most perfect ever invented, working with almost human intelligence and precision. Few screws are exported, owing to the severe competition of the great screw-manufactories of Birmingham, but the American article is generally regarded as more perfect than any made abroad.

Shovels and spades were manufactured in this country, in Massachusetts, as far back as 1776, in a small way; but since that time the methods of manufacture have improved so rapidly and intelligently that the American product now far outstrips that of the rest of the world. The Ames factory at North Easton, Mass., has a world-wide reputation, and exports its goods in great quantities to almost all parts of the civilized world. There are many other large factories in this country, producing an enormous quantity of these goods annually. The American goods are greatly preferred to the foreign article, because of their being vastly superior in quality and attractiveness, giving far greater satisfaction, and having less weight, whereas the foreign goods are heavy and much more clumsy. There are about fourteen shovel-manufactories in this country, with a total product of about 400,000 dozen shovels and spades.

Horseshoe-nails are prominent among the manufactured articles distributed by the hardware trade. In 1859 Mr. Putnam, of the Putnam Nail Company, undertook to make a black horseshoe-nail the same as the English "Griffin," and was the only manufacturer in this country who succeeded in making one identically the same, unless, perhaps, it was the old Forge Village Nail Company. The progress of horse-nail making in this country was very slow, and it was not until 1872 that much had been done in this line. After that the progress was rapid, and soon thereafter the foreign goods were entirely driven out of the market. Nails in this country are made by what is called the hot forging process, and are hammer-pointed. None are made in this manner abroad, and for that reason the American horse-nail is far superior to those made in other countries. There are twelve horseshoe-nail manufacturers in the United States, employing about 1000 people, with a capital of about $2,000,000, having a total product of, say, 9000 tons, which have a market value of over $2,000,000.

Wire nails, which have so rapidly superseded the cut nails, were not made in this country until 1886, at which time they were first produced and put up in kegs the same as cut nails. The total production that year was 600,000 kegs. In 1887 this output was doubled, and continued increase has been shown each year since until the year 1894, when the product was 5,681,801 kegs, with an estimated product for the year 1895 of from 7,000,000 to 7,500,000 kegs. These goods are made so cheaply in this country that they have been exported to some extent. One single order for American wire nails was taken in London for a lot of 60,000 kegs, in January, 1895, the goods being produced and sold cheaper in this country than anywhere else in the world. At present there are sixteen wire-nail mills in operation in the United States, controlled by ten different companies, with a capital invested of about $8,000,000. The value of the product, based upon present prices, is $15,000,000. There are 5000 people employed in the wire-nail mills.

Barbed wire was first manufactured in the United States in 1874, at De Kalb, Ill. In that year there were not over 500 to 600 tons produced, and the price was twenty cents for painted wire. The next year the product increased to 3000 tons, and five years later (1880) it had made such a great gain that the record was 100,000 tons; while for the year ending March 1, 1895, the total product was 190,000 tons, at which time the average price, which was originally twenty cents, was reduced to about one and one half cents per pound. Of all the barbed wire manufactured in the world fully ninety per cent. is produced in the United States, and there are annually exported from 20,000 to 30,000 tons. Of this amount the Consolidated Steel and Wire Company, with headquarters at Chicago, Ill., are exporting about ninety per cent.

At the present time there are seventeen barbed-wire mills in operation, with a capital invested of $8,350,000, and a total product, based upon present prices (1895), of $14,000,000, and employing 7000 people.

Tin-plate making is among our youngest manu-

factures, considered in reference to the amount of its product. No industry in the United States has shown such phenomenal growth as has that of the production of tin-plate. It is safe to say that there was substantially none of it prior to 1891. Since that time, or in the brief space of, say, four years, about seventy manufacturers have entered the field, nearly all of them equipped with the most modern plants and with ample funds to do the work in the best and most economical manner possible. The result is that home manufacturers are to-day in position to supply this country with at least one half of its consumption; and when it is realized that the annual consumption is about 6,000,000 boxes, or in the neighborhood of $21,000,000 in value, the importance of this wonderful growth can be appreciated. Prior to 1891 almost all of it was imported from England, whereas now it is a question of only a short time when the home manufacturers will not only control the entire market of the United States, but will be seeking other fields to conquer. The native product is superior to the foreign both as to the quality of steel used for tinning, and again in that advantage which Yankee ingenuity almost invariably brings—labor-saving machinery of every kind. The Welsh tin-plate makers have progressed very little since they began the industry, and the prospects are that a hundred years from this date will find them just where they are now; while the American manufacturers have already made radical changes and introduced a number of marked and valuable improvements.

The American hardware man has often been said to be a philanthropist rather than in the ordinary sense a merchant or shopkeeper, for the reason that he gives better value for the money that is spent with him than is done in any other line of business. An investment of a dollar in his store will last longer, be more useful, do better work, give greater satisfaction, and receive a higher degree of appreciation than will a similar investment in any other article or class of goods that is made. A mechanic will frequently, after using a tool for which he has paid perhaps one dollar, become so attached to it by reason of its excellence that he would decline to sell it for five dollars. It is a fact that many times a barber who has purchased a razor for a single dollar will, after years of use, be offered five or ten dollars for it. In this sense, perhaps, the claim of philanthropy may be defended. Another view of it was presented recently in the case of a distinguished lawyer who was traveling over one of the Northwestern railways, having with him his son, a young man just from college, to whom he was showing the road. The latter asked for what purpose the ax and handsaw which were covered with glass at the end of the car were used, to which the father replied:

"That is for a very peculiar use in this country. The railroad companies have found from experience that when accidents occur and people are killed the surviving heirs usually bring a damage suit for about $5000, that being the customary figure for which suit is brought; whereas if a passenger is wounded, maimed, or mutilated, he brings suit for $25,000, $50,000, or $100,000. Hence these saws are placed at the end of the car, so that in the event of accident, where passengers are wounded, the conductor and brakemen may immediately kill them, saw them up, and thereby reduce the amount of damages that will be asked for."

CHAPTER XCVIII

THE STATIONERY TRADE

IN early days dealers in books were denominated *stationarii*, probably from the open stalls at which they carried on their business; though *statio* is a general term in Low Latin for "shop." They sold, among other things, materials for writing, which have retained the name of stationery, although now embracing thousands of articles then wholly unknown. Indeed, long before the invention of printing there flourished a craft or trade called stationers. D'Israeli, in his "Amenities of Literature," says: "They were scribes and limners, and dealers in manuscript copies, and in parchment and paper and other literary wares." The stationer's stock consisted largely of books or works in manuscript, which were transcribed, loaned, or sold. To these were added parchment, paper of various kinds, ink, quill pens, sealing-wax, etc. But after the introduction of printing, and the commencement of the manufacture of paper in an organized way, he became, as it were, a dealer in all kinds of articles which pertained to the literary vocation. To-day he is not only stationer *per se*, but also, to a greater or lesser degree, designer, printer, engraver, lithographer, photo-engraver, and bookbinder; for in the ramifications of his business he brings into use all of these different callings, in order to satisfy the multiplying wants of his customers. The latter nowadays include merchants, bankers, brokers, railway and steamship men, lawyers, doctors, journalists, and ministers, as well as all classes of the body politic, each of which, in turn, requires something different from the others in the general stationery line. Such being the case, it is difficult to define in the large modern wholesale or retail establishments of this description that part of the stock or business which is strictly stationery and that which belongs to fancy goods or to other kindred branches of trade and manufacture. The tendency of the modern distributing trade in nearly all lines is to return to first principles; that is, to group together under one roof a heterogeneous assortment of articles that bear no direct relationship to one another. This tendency is as manifest in the stationery business as in other departments of merchandise. The crude hand-paper, old inkhorn, and "gray goose-quill" of older days have been supplanted by almost numberless articles of greater beauty and convenience answering like purposes.

The Guild of Stationers in London, England, which was the earliest organization of the kind known in England, was formed in 1403, many years prior to the introduction of the art of printing into that country by Caxton. It was chartered as the Stationers' Company by Philip and Mary in 1556. The charter was renewed by Queen Elizabeth in 1559, exemplified in 1684, and confirmed by King William and Queen Mary in 1690, and as such exists to this day. The guild owns and occupies the building known as Stationers' Hall, in which is kept a book for the registration of the copyrights granted in the United Kingdom.

Toward the close of the seventeenth century, when New York had been under the domination of the English for over a score of years, it was resolved to establish printing here on the same plan as that already in existence at Cambridge, Mass., and at Philadelphia, Pa., where William Bradford, printer, had located. In connection with Rittenhouse, Bradford built the first paper-mill in this country, which was erected on a branch of the Wissahickon, known even to this day as Paper-Mill Run. Conjoined with Bradford and Rittenhouse in this enterprise were Robert Turner, Thomas Tresse, and Samuel Carpenter, also of Philadelphia. The mill was built in 1690, and was composed of rough, unhewn logs put up in the same style as were many of the dwelling-houses of those early days. Some years later Bradford removed his printing-

press from Philadelphia to New York, and established himself there; thus depriving the former city for a number of years of a printing-press.

It may be well in this connection to particularize the printing-presses which had been established in this country up to this date. Cambridge, Mass., had one as early as 1639; Boston, one in 1675; Virginia, one in 1682, which was stopped by Lord Effingham in 1683, and no printing again allowed to be done there until 1729; Philadelphia, one in 1685, which was removed to New York in 1693, and none again until some years later; New York, one in 1693; Connecticut, one in 1709; and Maryland, one in 1726. As to paper-mills, with the exception of the one near Philadelphia, none had been established in this country until 1725 or 1726, when Bradford erected one at Elizabethtown, N. J. Up to 1742 Bradford continued in the printing and stationery business in New York, when he was succeeded by James Parker, who carried on the trade successfully for a number of years afterward.

Hugh Gaine was another of the old printers and stationers of New York. He came originally from Belfast, Ireland, and became a journeyman for James Parker. In 1752 he began business for himself, and in that and the succeeding year brought out "Hutchins's Almanac," and a journal entitled the New York "Mercury," which continued to be regularly published until the close of the Revolutionary War. His store was in Hanover Square, where he sold books and stationery, as well as carrying on printing and binding. He occasionally issued books on his own account. When the colonial army took possession of New York he retired to Newark, N. J., and remained there for a time, publishing a loyalist newspaper. At the close of the war he petitioned the legislature of New York for permission to return, which he obtained. He stopped his journal, but continued his printing, book, and stationery business. He died in 1809, leaving a fortune.

Aside from those already mentioned we have very few authentic records of other stationers in New York until about the beginning of the nineteenth century. Printing was then very much improved, as was also the manufacture of paper. In 1812, New York, besides one periodical (a medical quarterly), had seven daily, three triweekly, and two weekly journals, in which the booksellers and stationers especially had the largest advertisements, as they had the greatest number of articles for sale. They had supplies of stationery, including paper, ink, wafers, pumice, pumice-boxes, shining-sand and blossom-blotting paper, not to mention books, pamphlets, and a quantity of quack medicines. Printed forms then were few, as every lawyer engrossed his own matter. There were no printed cards like those which have since come into use. Probably the whole of the job printing then done in the entire United States was not, in amount, equal to that done at the present day in some interior village.

Stationery was not distinct from printing and bookselling until 1810 and even later. It was declared by a stationer who did business shortly after that time that "the stock of the stationer proper usually consisted of a few quarts of ink, a ream or two of writing-paper, and a barrel or two of black sand, the people making their own quill pens." Writing-paper until after 1830 always had a rough surface, and was made only in three or four sizes. Sealing-wax was then an important article; envelopes were not practically in existence, although some few crude hand-made affairs had been shown earlier in Europe.

The early directories of the city of New York give the names of no paper dealers, and but a moderate number of those engaged in the kindred lines of printing, publishing, and bookselling. David Longworth published directories at the Park. The exact location was where Hitchcock's music-store now is, on Park Row.

From 1786 to 1796, Robert Hodges, stationer and bookseller, was located at Maiden Lane, and carried on a very successful trade. Following him, the name of Doubleday appears more or less prominently in the trade, in which it continued for over three quarters of a century. Contemporary with him in the early days was Duyckinck, located at 110 Pearl Street, who continued in business for a long time. He was a very extensive publisher. In 1831 we first hear of David Felt, of Boston, who established himself here, and afterward at Feltville, N. J., where he engaged in the manufacture of stationery, etc. He was a man of strong individuality, with almost revolutionary tendencies in his methods for the advancement of the stationery trade. He was carried down in the panic of 1857, and never was a factor in business afterward. In 1837 the name of Louis I. Cohen first appeared as an importing stationer of prominence. He amassed a competency, and lived to a ripe old age in which to enjoy the fruits of his industry. Among the names that have been continuous in the stationery and kindred trades for the last fifty years, and whose successors are still active in business in New York to-day, are Bowne & Company, established in 1837; E. B. Clay-

ton & Sons, in 1846; Francis & Loutrel, in 1844; and W. A. Wheeler, in 1849.

About 1845 Richard Bainbridge first came to New York, and a change was introduced in the mode of doing business. He began the English and continental method of traveling with samples, and obtained large orders from the start, not only from the few importers on the coast, but from jobbers, who from this time were prominent buyers of foreign goods. About 1850 the house of Richard Bainbridge & Company was established in New York, and began to carry a stock here. After the panic of 1857 Mr. Bainbridge left the stationery business, and the firm was changed to Bainbridge Brothers. In 1861 the firm became Henry Bainbridge & Company, which still continues at 99 and 101 William Street, where it originally was formed, being familiarly known throughout the United States as a legitimate and exclusively wholesale house. Mr. Benjamin Lawrence began the importing of stationery about this time, and afterward, as B. & P. Lawrence, became the largest importers known in the history of the trade. Henry Cohen was established in Philadelphia at this time, and his son, Charles J. Cohen, worthily succeeded his father, more, however, as a manufacturing stationer than as an importer.

In Boston, Benjamin and Josiah Loring, twin brothers, had established themselves in business as bookbinders in 1798, and were located on Water Street, where they continued together until 1805, when they separated, Benjamin remaining at the old place and Josiah being on Devonshire Street. In 1810 the latter was located on School Street as a bookbinder and paper ruler, removing thence in 1813 to 1 South Row or Marlborough Street, opposite School Street, where J. L. Fairbanks has been since his death. Benjamin Loring in 1807 removed to State Street, where he remained until 1810, then changing his place to 50 State Street. About this time Edward Cotton was doing a good business on Marlborough Street, and some ten years later, in 1820, David Felt was also largely engaged in the stationery business at 83 State Street. This was the David Felt who afterward removed to New York, and finally to New Jersey. Charles Himpson, the publisher of the "Boston Directory," Samuel G. Goodrich ("Peter Parley"), Leonard C. Bowles, and Andrew J. Allen, all on State Street, were also among the principal stationers of the same period. Lemuel Gulliver succeeded David Felt, and Thomas Groom, an Englishman, from New York, shortly afterward took the place of the former, especially in the stationery line, in which he had not proved very successful. There were also about this time many stationers in Cornhill, Boston, doing a moderate country trade; but there were few successful ones among the number. Jones & Oakes, Jones & Holman, Oliver Holman, and Aaron R. Gay successively occupied 124 State Street. Mr. Gay is still in business at the old quarters, which are now known numerically as 122.

About the year 1816, John Hooper, a young Englishman, who had been in a newspaper printing-office in New York, came to Benjamin Loring to learn the bookbinding business; but his employer, finding him useful and efficient in the store, kept him there, and finally, in 1826, admitted him to a copartnership interest in the firm, which at that date was known under the style of Benjamin Loring & Company. Thus it will be seen that Thomas Groom & Company and Benjamin Loring & Company were prominent stationers in Boston at this early date; and while the former name still continues the same, the latter was succeeded by Hooper, Lewis & Company, both being favorably known throughout Europe and the United States as extensive importers of and dealers in all counting-house requisites.

Previous to 1845 travelers in this line of business were unknown. At the present day most of the wholesale business is done either by travelers or by mail. The principals in the trade seldom meet one another, except occasionally in an incidental or social way. Formerly it was thought necessary for all the large dealers at a distance to visit New York, Boston, and Philadelphia once or twice a year, as also for the importers to go to Europe. Travelers and samples, through our excellent mail and railway facilities, have changed all this, and the merchants living in remote sections of the Union can now get their supplies as promptly and satisfactorily as if they were on the spot in person to select for themselves.

Chicago fifty years ago was of little importance from a stationer's point of view, but in less than ten years afterward it developed some of the largest buyers of stationery. Among the great Chicago houses the firm of A. H. & C. Burley may be mentioned as large manufacturing stationers and jobbers. When the Illinois Central, Rock Island, and other railroads running out of Chicago were being built, foundations were laid for a progress in that city that makes it to-day the market to which our manufacturers and importers are equally attracted. Chicago can boast of more first-class stationery-stores than any other city in the United States. The farther west we go, attractions increase. St. Louis has many

John G. Bainbridge.

large manufacturing and jobbing houses in this line, that are substantial and impressive. The business established by Mr. Loring in that city is now known as the Robert D. Patterson Stationery Company, and has been active in the trade for more than half a century.

San Francisco has several houses worthy of that enterprising and favored land of sunshine and flowers. H. S. Crocker & Company have one of the most complete manufacturing establishments on the Western coast. Payot, Upham & Company, another enterprising house in that city, are favorably known on the Eastern as well as the Western coast. The large firms in San Francisco are probably better equipped for work than most of our Eastern manufacturers, because, being farther from the center of activity, they have naturally become more self-reliant.

The growth of labor-saving office devices has been remarkable during the last twenty-five years. In all modern offices will be found files, clips, and filing-cases of varied and complete manufacture, so carefully and economically arranged that it is no longer necessary to overhaul a lot of old boxes and bundles of former years' accumulation, but one can go directly to his index and in a few minutes examine any records required, each being readily returnable to its proper position in the files, neither defaced nor damaged. Cameron, Amberg & Company, of Chicago, were the first in the market with their cabinets, filing-cases, and indexes, and reaped great benefit from them almost from the beginning. Up to this day this firm is prominent in labor-saving devices, favorably known in mercantile and legal offices. Shannon's files, indexes, and filing-cases have a world-wide reputation, and are second to none in usefulness and popularity. Brower Brothers, of New York, came later in the field, but steadily and surely won their way to public favor. The Globe Company, of Cincinnati, has gained a well-deserved reputation for many novelties in counting-house requisites, and its fame has reached the utmost limits of the United States, and its wares are familiar to many parts also of the outside world.

Turning now from the consideration of the personnel of the stationery trade to its methods, features, and business operations, we find great changes since 1795. Papeteries, pads in all styles, and devices from the cheapest pencil paper to the fine stamped initial have seriously injured the stationer, upon whom we formerly relied for the sale of the monograms and special styles which are so necessary for every well-regulated writing-desk and library.

The paper maker may not regret the change this class of manufacture has brought about, but the stationer proper has great cause to do so, as all classes of merchants throughout the country can and do sell a pad or papeterie, with or without envelopes to match, for a nominal profit. No technical knowledge or training is required to sell a package for ten cents that cost nine. The department-stores have been the greatest detriment to this part of the stationer's business.

Envelopes as now made and used are of very recent origin, yet their occasional employment as a covering for letters extends back several hundred years. The first ones were very crude, hand-made affairs, and, aside from the purposes for which they were used, bore but little resemblance to the machine-made article of to-day. In the English state-paper office there is said to be one bearing the date of 1696, which in shape or style resembles some of those in use to-day. In "Gil Blas," published in 1715, allusion is also made to the use of envelopes. But with the exception of the instances noted, envelopes, used as a covering for letters or written communications, made no showing whatever in a commercial way until after the introduction of penny postage in England, in 1840. Then they became common in that country, and in America some four or five years later. Congress made a marked reduction in the cost of postage, and made it uniform for all distances, in 1851 or 1852, leading to increased correspondence between the people of the various sections of the Union. The use of envelopes became still more common soon thereafter, and they were in great request. Up to this time they had been made by hand, and the process was necessarily slow and expensive. They were not self-sealing, but wafers and sealing-wax were then in every household and office, whereas to-day these articles are almost obsolete except for parcels.

The earliest manufacturer of envelopes in New York was an Englishman named Dangerfield, who began about 1846, and was followed by Samuel Raynor, whose successors, the Raynor Envelope Company, are to-day to be found in William Street, where in the manufacture of millions of this article they employ machines which are beautiful examples of perfected mechanism, and which go through with all the varied processes of the making in about one second. The daily consumption of envelopes alone in this country is almost beyond computation, for the reason that the letters which go through the mail form but a part of those used locally and otherwise in an unstamped condition.

The pencil was probably the first instrument used

by artists. It consisted of lumps of colored earth or chalk, cut in convenient form for holding in the hand. With such pencils were executed the line-drawings of Aridicies the Corinthian and Telephanes the Sicyonian, and also the early one-colored pictures or *monochromata* of the Egyptians and Greeks. The manufacture of lead-pencils by machinery, however, is of very modern origin. In this country the first lead-pencils were made by Mr. Louis J. Cohen, about 1837, who soon discontinued their manufacture, and the German lead-pencil began to control our markets. The rapid growth of domestic pencil manufacture, fostered by protection in the closing decades of the century, has driven imported pencils almost out of the country, save the higher grades, which cannot as yet be produced here with profit to the makers. The export trade in medium grades of pencils has already reached important proportions in our foreign commerce, and promises to attain to still greater enlargement in the near future.

The earliest pen, we are told, was a kind of reed, split or so fashioned as to retain and give off, as required, colored liquid, or ink, as it is now generally termed. Quill pens came into use about the time of the introduction of modern paper. At the beginning of this century pens began to be made wholly of metal. They consisted of a barrel of very thin steel, and were cut and slit so as to resemble the quill pen as closely as possible. They were, however, but indifferently successful, and, being expensive (the retail price at first being half a crown, and subsequently sixpence), they made but little headway. Their chief fault was hardness, which produced a disagreeable scratching sound on the paper. In England, in 1820, Joseph Gillott, who dealt in the metal pens then made, hit upon an improvement which, by removing this great defect, gave a stimulus to the manufacture which caused it to be developed to an extent truly marvelous. This consisted in making three slits instead of the single one formerly, and by these means much greater softness and flexibility were acquired. He also introduced machinery for the purpose of carrying out his improvements. In this country the old-fashioned quill pen held supreme sway until about 1844 or 1845, when the steel pen began to be more generally used, at least commercially, although the former was employed for many years later to a very large extent in households, schools, and colleges. To-day, however, the rising generation hardly knows what a quill pen is, so rapidly have metal pens of all grades taken its place.

We are told that nothing much was known about ink by the ancients. The use of the stylus, however, indicates the employment by them, as well as by Asiatic peoples in general, of carbon inks. Indeed, Pliny, Dioscorides, and other ancient writers give evidence that carbon in the form of soot was the essential constituent of ancient ink; and in early modern history we know that liquid preparations made from various vegetable and mineral substances were used. But ink corresponding in kind and character to that employed to-day for writing purposes came into use in Europe about the time that paper manufacture and block printing were introduced there. In this country Thaddeus Davids was probably the earliest one to engage in the manufacture of ink on a large scale or in an organized way. He made ink for writing and copying purposes, and he has been followed by several noted manufacturers. In printing-inks especially the business has assumed enormous proportions, and as to writing-fluids of the various descriptions, they have become household and office necessities, the manufacture and sale of which are also of large proportions. Of late years the type-writer, with its prepared self-inking ribbon, for general commercial purposes, has made a serious inroad in the sale of writing-ink proper. Slates and slate-pencils are doomed and are going out of use very rapidly.

In the foregoing but a few of the chief articles made or handled by the stationery trade, wholesale and retail, have been enumerated. Among those most commonly sold by the retail trade of the present may be mentioned the following: arm-rests, albums, rubber bands and rings, backgammon, chess, and checker boards, baskets, alphabet and kindergarten blocks, blotters, pads, book-covers, boxes, tin, bone, wood, and japan paper-cutters, penholders and pens, paints, writing-papers (flat, folded, and boxed), paper-weights, rubbers, rulers, school-bags, school-books, scales, sealing-wax, seals, shears, scissors, twine, slates, sponge-cups, straps, tags, suspension rings, tapes, tape-measures, toothpicks, tracing-cloth, wafers, eyelets, pins, wires, etc.

Many of our retail stationers have also newsrooms, book-stores, small printing outfits, and tobacco and cigars united with their other business, so that it is often difficult to tell what part or parts belong strictly to stationery. In fact, as previously observed, the stationery business, both in the manufacturing and selling departments, in the United States is so closely related to the paper manufacture proper, the printing, bookbinding, and booksell-

ing trades, as well as other industries, that it is hard to get any accurate figures with which to make a numerical exhibit of its progress. The census reports do not afford any very definite idea of its growth or present status. From the imports and exports as reported by the government it is possible to obtain some idea, although there are certain generalizations in the classification of articles under this head that render exactitude impossible.

The importation from abroad of writing and book papers has fallen off materially of late years. Except hand-made papers for drawing and ledger purposes, the American papers are equal to all requirements. Without going into a detailed analysis of the above summary, however, it will be seen that our imports of paper and paper manufactures are still largely in excess of our exports of the same articles, including stationery not made of paper.

IMPORTS AND EXPORTS OF STATIONERY, 1869-1894.

Articles.	1869.	1870.	1875.
Imports:			
Writing-paper........	$259,353	$132,480	$27,170
Exports: (Dom.)			
Paper and stationery..	[1]460,268	514,592	740,258
Writing-paper........	568	981	646

Articles.	1880.	1885.
Imports:		
Paper, and mfrs. of	$1,671,120	$1,592,892
Exports: (Dom.)		
Writing-paper and envelopes	[2]1,189,498	77,418
Stationery, except paper	....	395,123
All others	....	793,037

Articles.	1890.	1894.
Imports:		
Paper, and mfrs. of.	$2,816,860	$2,628,351
Exports: (Dom.)		
Writing-paper and envelopes	125,041	84,305
Stationery, except paper	490,673	683,278
All others..........	1,002,144	1,713,929

[1] Includes paper and manufactures of paper.

[2] Includes stationery, except paper.

John Geo Bainbridge

CHAPTER XCIX

OTHER INDUSTRIES

ALUMINUM

THE aluminum industry in the United States has become of considerable importance, and though still young, it promises to be one of the greatest of American industries. The American manufacture has grown from practically nothing in 1884, until now the value of the annual output amounts to $450,000, one third of the total supply of the world coming from the United States. The manufacture of pure aluminum in this country for industrial purposes was begun by the Pittsburg Reduction Company at Pittsburg in 1888, under what are known as the Hall patents (an electrical process). Three years previous to this the Cowles Company, located at Lockport, N. Y., made aluminum alloys, but the Pittsburg Reduction Company is now the sole American producer. Its founders were Charles M. Hall, inventor of the electrolytic process, Alfred E. Hunt, now president of the company, and George H. Clapp, at present secretary. In 1891 the company's plant was moved to New Kingston, Westmoreland County, Pa., where its works cover ten acres of ground. Within the past year the company has opened works at Niagara Falls, being the first manufacturing plant to receive electric power from the falls. In 1884 the price of aluminum was $16 per pound. The first metal produced by the Pittsburg Reduction Company in 1888 was sold for $8 per pound. In a short time the price was reduced to $4, then to $2; but aluminum is now sold by the Pittsburg Reduction Company in large quantities at prices as low as thirty-five cents a pound. The metal is now able to compete with copper and brass in price, when the relative specific gravities of the two metals are taken into consideration, the specific gravity of aluminum being 2.56, brass about 8.21, and copper 8.93. It is thus seen that from the beginning of the production of aluminum by electricity in the United States, ten years ago, the metal has steadily forged to the front, as one of the most important in the useful arts. The greatest single achievement in the use of aluminum to date was in the use of the metal in the construction of the yacht *Defender*, the American champion in the great international yacht-race for the *America's* cup, off the New Jersey coast, in 1895. The *Defender's* plates above the water-line, her deck-beams, and all of her fittings were entirely of aluminum. By thus using this substance on her topsides, deck-beams, and fittings, the *Defender* was given great lightness above the water-line, and more weight could be put in her keel, which greatly added to her stiffness. Within the next few years it is believed that several American yachts will be constructed wholly or in part of aluminum, and that the metal will also enter into the construction of large ships. Several aluminum torpedo-boats have been constructed abroad during the past year for foreign navies.

One of the most beneficial results of the use of aluminum is to give the country a substitute for

wood for many articles. Owing to its lightness it has been substituted for wood in parts of machinery where no other metal has heretofore been found practicable. In marine work, particularly, aluminum, it is said, will replace ordinary timber, as well as other metals, in upper works, rigging, and fitting. There seems to be no limit to the number of uses to which it may be put, owing to its great strength and lightness; and, though the youngest of the metals in practical application, it is apparently destined to be one of the greatest and most useful.

TYPE-SETTING MACHINES

Type-setting machines have now been in use in the United States more or less since 1850, and have been known through patents since 1840. The first one of the kind, however, which was actually at work for any length of time was the Mitchell, which was employed in New York from 1855 till 1867 or 1868. It dropped types on belts of different lengths, so that the characters standing furthest from the operator reached the line as soon as those nearest. One dozen of these were all that were made, and they were used in only one office. About 1870 the Burr machine came into use, followed by the Thorne and the McMillan. All are constructed with keyboards like a type-writer, and touching a key displaces a type from the end of a line stored much higher than the keyboard. It drops into grooves which are so contrived that the letter cannot turn around while falling, all the grooves converging toward a common center. When the character reaches this place it is stopped in its fall and gently moved forward against the preceding letters by means of a flutter-arm or beater. After sufficient letters have been dropped to complete a line it is spaced and justified by hand. After being used the characters are separated and returned to their grooves by a distributing-machine. A set of these machines requires the labor of about two men and a half, and it is able to perform the work of from four to eight compositors. Another type of machine, entirely distinct from this, is one in which the molds or matrices for the characters are assembled, spaced, and justified, a cast of the line then being made. It requires no thought for the spacing or justification, these operations being automatically performed; nor does it need to distribute, as, when the lines have once been used, they are thrown into the melting-pot. This machine was invented by Ottmar Mergenthaler as early as 1876, but experimenting continued until 1886, minor changes having since been made. In the year just mentioned machines were put into the offices of the Louisville "Courier-Journal" and the New York "Tribune." Until about 1891, however, the expenditures of the company were much greater than the income, and the projectors were frequently in financial straits. The machine has been adopted in nearly all the larger daily newspaper offices of the United States, and in many of those of the second and third rank, between 2000 and 3000 now being employed. This machine does work equivalent to that of four or five men. Factories have been built in Brooklyn, Baltimore, Montreal, and Manchester, England. The capital invested in the company is about $5,000,000, and its annual out-turn at present is about $3,000,000. This machine is a marvel of ingenuity, as are several of the machines which handle movable types. The most largely used of the latter is the Thorne, with an output of about $300,000 a year. Recent notable advances in popular favor must be credited to the Empire machine, which is now being introduced into the office of the New York "Evening Sun." The McMillan machine has been found adaptable for book composition, and is in use at the De Vinne Press. An invention which casts individual types as well as sets them, is known as the Lanston Monotype Machine, and is now in operation in the composing room of the "Philadelphia Inquirer." Immense sums of money have been lost in the invention and exploitation of these machines. It is understood that $600,000 has been sunk in the Paige, probably the most ingenious and complicated machine ever invented by man; while the Mergenthaler is said to have lost $1,300,000 before it reached the paying point. Perhaps 1200 persons are employed in the manufacture of all that at present are for sale.

ATHLETIC AND SPORTING GOODS

Athletic goods are a product chiefly of the last thirty years. Gymnasiums existed before that time, having been begun as early as 1850; and dumb-bells and a few other articles were made in small quantities previous to that year by a few manufacturers, being sold to the general trade as hardware, books, stationery, and toys are now sold. Guns and gun implements, of course, are not included in this statement. Peck & Snyder, of New York, began dealing in base-ball goods in 1865. That game had become common in 1855, but was then always played by boys; and cricket was really introduced into this country by an English team about 1856, although the game had then been played by an

English club in New York for several years. In 1858 there was no special ball employed in base-ball, and no regulation style of club. Other lines of goods were added by Peck & Snyder to their toys, games, and miscellaneous articles. They were the first to inaugurate what might be called the special sporting-goods business. The A. J. Reach Company, of Philadelphia, began business in the same way in base-ball goods about 1867, and Wright & Ditson in Boston in 1871. A. G. Spalding & Brother took up the same line of trade in Chicago in 1876, confining themselves exclusively to sporting-goods, base-ball requirements being the chief part, for that sport at the time was the only one which commanded any very great attention. In 1878 they began at Hastings, Mich., the manufacture, especially for their trade, of base-ball bats, Indian clubs, fishing-rods, and all athletic goods in which wood predominates. This factory burned down, and the goods were subsequently made in Chicago. They have since added several factories in other parts of the country. A number of other houses have embarked in the manufacture of this class of goods, which includes bicycles, the equipment for fishermen, hunters, and canoeists, with their special garments, and everything necessary for games. The total amount of business transacted in the United States, excluding guns and bicycles, is between $3,000,000 and $4,000,000 a year, the number of hands being about 5000, and the amount of capital employed exceeding $3,000,000.

AWNINGS, TENTS, AND SAILS

In the dry and sunny climate of the Orient there is not the imperative necessity for a house which is found in England and the United States. There are particular advantages in a tent in Arabia, the Holy Land, or the Great Desert of Africa, which render it, on the whole, more desirable than a solidly built edifice. One chief advantage is in the ease with which migration can be effected. At night a traveler is in one place; to-morrow he may be fifty miles distant. Tents are chiefly used in Europe and the United States as shelters for soldiers, although the first hunters in this country, following the Indians, made partial use of them. But since 1860 many people who have good houses with every comfort desert them in the summer-time, and pitch their tents on the edges of lakes and streams or upon the mountains. The Adirondacks are filled with them in the summer-time, and they are in great abundance on the shores of the minor lakes of New York, Wisconsin, and Minnesota. Awnings became common here first in the South, and have moved farther North only within forty years. Originally they were introduced into Europe by the way of Spain, when the Mohammedans penetrated that country. Sails also are of great antiquity. The adventurous mariners who left Phenicia and went to the far-distant coast of Britain to obtain tin undoubtedly employed sails on their vessels; and to this day, great as is the number of steam-vessels, they bear no comparison with those which depend upon wind as a motive power. Sails are chiefly made of duck or canvas, as are tents; awnings can be made of a lighter and less substantial cloth. The places of manufacture for all of these are on the seaboard, but none of them are large. Duck manufacturing is carried on in New England. The total value of the product in the last census year was $7,829,003, and the number of establishments was 581.

PRINTING-PRESSES

Printing-presses were not manufactured in the United States before 1795. When needed they were constructed by an ordinary carpenter and joiner. At about that time, Adam Ramage, a native of Scotland, began making wooden hand-presses in Philadelphia, continuing the business through the whole of a long life. A great improvement was made in England in 1802, by which the whole of the apparatus was made of iron instead of wood, as had been the custom previously; and this was imitated in America in 1818, John J. Wells then devising a new iron hand-press. He was followed by Rust, Turney, and others. Peter Smith, a brother-in-law of Robert Hoe, invented another one about 1822, and induced Hoe to embark with him in its manufacture. It proved successful, and Hoe afterward bought out the press of his principal competitor, Rust, which after a time drove out all competitors, then being known as the Washington press. It is still in use, but as the patents have long since expired it is now made by several firms. Both the metal press and the wooden press were, however, very slow, and in 1821 and 1822, Daniel Treadwell, an ingenious Yankee, devised a machine that did twice as much work as the hand-press. This was burned up in a fire which consumed his printing-office in Boston, and he invented another type of machine, which was in successful use in the Bible House in New York in 1828 and 1829. Two mechanics named Tufts and Adams made improvements upon it which led to its being superseded. The Tufts did not continue in use for more than fif-

teen years, but the Adams, which was largely sold, is not yet entirely laid aside. The great success, however, which had been attained by the machine invented by König in London in the year 1814 led to the importation of an improved form of it for use in New York about 1827. Within two years Hoe was engaged in the manufacture of machines similar to it, which in 1830 were employed in several offices. They were what was known as the Napier press. By 1836 a double cylinder was in use, invented by Colonel Richard M. Hoe, who had succeeded his father. In 1847 he succeeded in producing a rotary press, in which the types were fastened upon a revolving cylinder, each turn of the machine producing four sheets. A little later, Applegarth, an English engineer, produced a machine somewhat similar in idea, but not so well contrived; and this, after twenty years of use, was finally superseded in England by Hoe's machine. The four-cylinder not proving fast enough, six, eight, and ten cylinder presses were made, the latter being of immense size. Up to about 1853 Hoe had really no competitors in his own line of presses except A. B. Taylor, of New York, who had once been a foreman in his establishment and had begun for himself about 1840; and they, with Adams, of Boston, controlled all the press building in the United States for many years. Between 1850 and 1860 appeared, however, a number of persons who contested the market with Hoe and disputed his theories of construction. Each began the building of machines. The successors to them are the Potter, Campbell, Babcock, and Cottrell companies, whose machines have been excellently made and are very popular. At about the same time small presses came into use, although they had been made to some extent for twenty years before. The earliest successful makers in numbers were Ruggles and Gordon; Degener followed during the Civil War; and later came the universal press, now made by Gally and Thomson, but by the latter under another name. A multitude of changes have taken place since 1850. Ink is better distributed, the castings are truer and the jar less, and the extensive introduction of woodcuts has necessitated the employment of workmen of higher skill, who in turn have demanded better presses. It was once the custom to print everything on wet paper, but now almost everything is printed on dry. Just before the beginning of the war, paper stereotyping was introduced, which enabled two or three presses to be employed at the same time upon the same pages of a newspaper. More presses were bought by each establishment, so that they might be available for contingencies. By the use of paper stereotyping, also, smaller cylinders could be employed, and the whole size of the machine could be lessened. Bullock succeeded in making a press in which he availed himself of these advantages and of the use of a roll of paper to feed the press, no hand-feeding being required. This was elaborated still further in England, and reintroduced into America with modifications by R. Hoe & Company about twenty years ago. Printing thus became much cheaper, and a great impetus was given to the manufacture of presses. Instead of a newspaper having only one press, as was the case with the New York "Sun" in 1850, and requiring eight hours to print its edition on one side, newspapers of 50,000 circulation now have half a dozen presses, capable of printing 50,000 copies in half an hour. Other press builders also make these machines, notably Scott and Potter; and, in fact, nearly all the builders pay attention to all lines, except job presses. There are about thirty builders in the United States, Chicago and New York being the chief centers of sale. The figures for this industry are not separated by the census, but the production is about $6,000,000, and the number of men employed about 3000.

UNDERTAKERS' FURNISHINGS

The undertaker's business is now a very much easier one than fifty years ago. Everything he requires he can obtain ready-made. In 1847 there were about twenty coffin warehouses in New York, but they manufactured little else. In small towns throughout the country it was the habit to make the coffin after the decease of the person for whom it was required, this being a regular part of the cabinet-maker's work; and nearly every body was buried in a shroud. In Europe carpenters still make coffins. About 1850 it was seen that as every coffin required a lining, and as there were other fittings needed besides the wooden part, there might be a future for a house in this line dealing chiefly in trimmings and dry-goods. William Fernbacher entered upon the manufacture of robes and linings, and Adolph Tuska, who kept upholstery goods and cabinet-makers' supplies, imported some German-silver plated trunk-handles, which were used for coffins. This trade in handles rapidly increased in its proportions, finally falling into the possession of J. M. Shanahan, who is still in business. The dry-goods part of the trade in New York is in the hands of five firms, who manufacture nothing but the goods required by undertakers. They also import

from Europe. These firms are Arnstaedt, Shanahan, Baxter, Tiedman, and Frank & Lambert. The capital now invested is $1,000,000; twenty-five years ago it was $250,000. There are about 75 manufacturers of handles and plates in the country, and 200 manufacturers of coffins and caskets. Approximately, there are about a dozen manufacturers of embalming fluids and implements, half a dozen firms making hearses, and as many making coffin trimmings, such as fringes, cords, and tassels. There are also outside boxes of metal and slate, as well as hinges and springs. Taken altogether, the goods annually manufactured for funerals in the United States are worth $20,000,000. Of this $8,000,000 worth are in dry-goods. If we add to this sum the coffins made in remote districts, the profits and the work of the undertakers, and the hire of horses and carriages, the burial of the dead cannot cost less than $100,000,000 a year. There are over 5000 funerals a day in the United States.

PHOTOGRAPHIC MATERIALS

Photography was discovered by Daguerre at Paris in 1839, and three years later the art was introduced in America. The Scovill Manufacturing Company, which was established at Waterbury, Conn., in 1802, is the pioneer manufacturer of American photographic goods, for in 1842 they made the metal plates for the daguerreotype process. As photography became popular, the department of the Scovill Manufacturing Company devoted to this branch became the Scovill & Adams Company, which has since become one of the largest manufacturers of photographic goods in the world. One of the other founders of American photography was Edward Anthony, who soon after the introduction of daguerreotypes established at New York City the first factory in America devoted exclusively to the manufacture of photographic goods. In 1852 H. T. Anthony became connected with the business, and the firm became E. & H. T. Anthony. Both of the founders are now dead.

The discovery of collodion in 1851 made photography easier and greatly increased the manufacture of photographic supplies. The next notable advance was the commercial production of gelatine dry plates in 1880. Though the use of collodion was an improvement over the daguerreotype process, it had many drawbacks until the advent of dry plates made photography possible among amateurs as well as professionals. John Carbutt, of Philadelphia, is considered the founder of the dry-plate process in America. After dry plates, the most important event in photographic annals was the development of photo-engraving, especially the half-tone process, which, though discovered in Germany, was never successful until improved upon in the United States. An important introduction which may be classed as distinctively American was the substitution of a sensitive paper for albumin-paper. No albumin-paper is made in America, and certain tariff changes increased the price, which resulted in the manufacture of several papers which are now considered superior to albumin. With the introduction of dry plates came amateur photographers in amazing numbers, and it is through the needs of amateurs that some of the best inventions in photographic apparatus have been made.

The manufacture of photographic supplies has grown tremendously within the last few years, and unique apparatus which have produced pictures with wonderful accuracy have been invented. In photographic inventions and in improvements the United States is now far in the lead, and its cameras, lenses, etc., are even exported to the very countries where photography originated. American photographic supplies are now known the world over, and it is estimated that there are at present $10,000,000 of capital invested in the industry, to satisfy the home and foreign demand. There were only $250,000 of capital invested twenty-five years ago, and only $25,000 fifty years ago. One of the old firms to engage in manufacturing photographic apparatus was the American Optical Company, which started in New York in 1858, and subsequently moved to New Haven, where it now turns out a fine grade of cameras, lenses, etc. In late years a number of factories have opened in Rochester, N. Y., devoted mainly to amateur photographic goods. These factories have patented apparatus, and a new style of plate known as the film variety, in which the gelatine is spread on celluloid instead of glass, as in the common dry plates. The pioneer in this line is the Eastman Kodak Company, of Rochester, whose kodak cameras have gained a wide reputation.

UMBRELLAS

The growth of the umbrella industry has been rapid in the United States during the past thirty years. Authorities in the trade agree that the manufacture was commenced here about 1800, at Philadelphia, Pa., by E. J. Pierce, W. A. Drown, and Edmund Wright. It did not progress very rapidly until about 1865. Prior to that date the materials

Albert Clark Stevens.

used in the manufacture were mostly cotton and alpaca. But five years earlier, or about 1860, American manufacturers began to use silk. Previous to that time all or nearly all silk umbrellas used in this country were imported from Europe. At the present time the estimated total amount of capital invested is placed at $3,000,000, as compared with $1,000,000 twenty-five years ago, and $250,000 fifty years ago. The approximate total number of umbrellas manufactured in the United States aggregates 9,000,000 per annum. Among the well-known manufacturers of umbrellas in the United States may be mentioned the following: Follmer, Clogg & Company; Ellis, Knapp & Company; the Excelsior Umbrella Manufacturing Company; and Charles Le Bihan & Company, of New York. In many respects umbrellas manufactured in this country excel those of any other, but particularly as regards finish, neatness, and close roll.

GLUE

GLUE is made from the trimmings of hides, bones, and sinews. It can be justly said that Peter Cooper was the founder of the glue industry in the United States, when, in 1827, he established works in Brooklyn, and from this business laid the foundation of his immense fortune. Though the West is now the center of glue manufacture, Peter Cooper's Brooklyn works have grown and are still in active operation, turning out the finer grades of this product. From this beginning in Brooklyn in 1827, and the establishment of another works in Philadelphia by Charles Baeder and William Adamson about the same time, American glue manufacture has progressed until now it is estimated that there are over $10,000,000 of capital invested in the industry, and the yearly sales amount to some $15,000,000. This is more than double the money invested twenty-five years ago, and ten times what it was fifty years ago. Glue is required in all sorts of woodwork, in the manufacture of clothing, in stiffening straw hats, and in a thousand and one industries where a gelatinous material is essential. The greatest quantity of glue is used in what is called the sizing trade. Paper is glazed with it, and oil and turpentine barrels are lined with it.

As the tendency of the times is for manufacturing plants to locate where cheap raw materials abound, so glue makers have opened plants at the chief cattle markets. Of late years the enormous packing-houses of Armour & Company and Swift & Company, of Chicago, and the Cudahy Packing Company, of Omaha, have built big glue plants of their own, thus utilizing the by-products of their own abattoirs. These cities have now become the great glue centers. The glue factories of the East draw their supplies largely from imported hides and from the bone refuse of the big cities. When the Australian rabbit-pest slaughter was at its height quantities of rabbit hides were imported to this country and boiled into glue. Many of the glue factories in the Eastern States are engaged in the manufacture of sand and emery paper as well, which industry is a large one and consumes much glue. Glue is best produced in a dry climate, and consequently the United States is favorable for glue making; though a dry climate is not absolutely necessary, as England, which is noted for its moist weather, has successfully engaged in glue making for years. American glue manufacturers no longer fear their English rivals, however, as considerable American glue is exported to the British Isles and to the world at large, the exportation amounting to about $500,000 annually. France is the only country which now makes a finer grade of glue than can be produced in the United States. The French have a process of their own of turning out the finest glues and gelatines from bones. They are imported and used in America mainly for straw hats. In the United States the finest glues are made from the sinews of cattle, and several factories are now experimenting to produce a glue equal to the best grades of France. In this the trade believe they will ultimately be successful. Among the distinctively American achievements in glue manufacture are methods for artificial drying, by which it is made much more quickly and cheaply. Another improvement is in manufacturing all the year around. It was formerly the custom to close in the summer-time, but now some of the American works have such improved methods that they can run the entire year without annoyance to the surrounding community. As Mr. Armour, of Armour & Company, expresses it, "I make my own weather." There are at the present time about 100 glue factories in the United States, all located north of Mason and Dixon's line.

ELEVATORS

THE business of manufacturing elevators in the United States has grown remarkably during the past quarter of a century, as a result of the erection of tall office buildings and other structures in which the machines are used as a convenience. The capital invested has increased from $20,000 in 1850 and $3,000,000 in 1875 to $15,000,000 in 1895.

The output in the United States in money value would, no doubt, amount to $20,000,000 per annum. The manufacture of freight-elevators was commenced in this country as far back as 1849, but it was not until 1859 that the manufacture of passenger-elevators was begun. In the latter year Otis Tufts and Henry Waterman started in the business at Boston, Mass. The business founded by them is now continued by the McAdams & Cartwright Elevator Company, who, with Otis Brothers & Company, the Reedy Elevator Company, the Crane Elevator Company, the Whittier Elevator Company, and Morse, Williams & Company, comprise the more important manufacturers in the United States. Although it is true the United States cannot claim the discovery of any of the broad principles on which either steam, hydraulic, or electric elevators are constructed, it can nevertheless be claimed that the machines have reached a higher stage of perfection in this country than in any other.

HATS

Hat making is one of the most peculiar of all industries, as it is probably the only one in which the maker takes the crude raw material and turns out the completely finished product. In this respect the manufacture of hats has not changed even with the introduction of labor-saving machinery and the general specialization of all branches of industry. The old-time hatter flourished in communities that bought many hats. Wherever there was a city or town, there were hatters to cap and hat the male population. The hatter formerly cut the fur from a felt, felted it, and after making the hat would wait upon the customer as well. The modern hatter has a factory where all this is done by skilled workmen and machinery, and the hats are now turned out by the thousands daily. Some of the first places in America to make hats and start shops were the towns of Danbury, Bethel, and Norwalk, Conn. The records speak of hat making in Danbury as early as 1734. Great hat factories have since been built in these towns, and they form to-day one of the leading hat centers in the United States. Among the other towns that early established hat factories was Albany, N. Y., where Benjamin F. Noahr started one in 1829. A few years later, Andrew Rankin and William Rankin opened shops in Newark, N. J., which city is now one of the important hat centers of the country. The business has grown from the time of these first days in hat making, until there is now estimated to be $30,000,000 capital engaged in the manufacture of all kinds of hats in the United States. We now furnish almost all of our own hats, do some exporting in felt hats to the South American countries, and send straw hats all over the world. There are also $250,000 of certain grades of hats imported annually. The material for making the various kinds of American headgear is nearly all imported. Beaver fur was the main material sixty years ago for fine hats, and at that time America could supply her own fur; but beaver hats have since become silk hats, only retaining the shape somewhat of the old beaver hats, but made with silk plush. This plush comes almost entirely from France, and all attempts to produce it in America have as yet been unavailing. Beaver nowadays is too expensive a fur for hats, and besides it is not considered as desirable as the imported silk plush.

Charles Knox was one of the early specialists in beaver and silk hats in New York City, and his son, E. M. Knox, now has one of the largest hat factories in the world, at Brooklyn, where all kinds of the finest silk and felt hats are manufactured. Robert Dunlap, of New York, has also an eminent name in the hat trade. Nine tenths of the felt hats worn in the United States are made from the fur of the rabbit and hare. Other furs used are the nutria, and those of the muskrat, the otter, the racoon, and the beaver. The rabbit and hare felts are entirely of foreign importation. Much wool is also used in the cheaper grades of felt hats and in the cloth of cloth hats. Felt is the principal material for the great bulk of the hats made in America. Cloth as a hat material has become much in vogue in recent years, owing to the great demand for all sorts of outing and uniform caps and bicycle caps for all seasons of the year. The styles of hats worn in the United States have changed with the freaks of fashion during the past one hundred years. After the three-cornered hat of the Revolutionary period came the regulation beaver, which held sway for many years, and finds its modern descendant in the silk hat. During the middle of the century the white cassimere high hat became popular and had a long run, but it is now out of style. When the Hungarian patriot Kossuth visited America he wore a soft hat trimmed with a black ostrich feather, and the soft hat then became fashionable in America, though never worn with the feather. The soft hat has always been a favorite in the Southern and Western States. Stiff hats, an English fashion, have been more or less in style for some time. A Tyrolean hat that was brought to this country by some American traveler has since

been modified and has become the United States army campaign hat. While no style of felt hat has originated in the United States that can be called distinctively American, many of the European shapes have been greatly improved upon and have become so common here as to be considered of American design. In cloth hats a number of new designs have originated in the United States. The finest soft hats are now manufactured in the United States, and are becoming more popular everywhere.

BILLIARD TABLES

THE origin of the game of billiards is lost in antiquity. Some historians believe that the game dates back as far as the time of Cleopatra and Marc Antony, while others state that it originated with the French and Norman-French. Billiards in America came into vogue with some of the early colonists, and at the time of the American Revolution was a popular pastime with many of the noted Americans of the period. George Washington, Alexander Hamilton, Thomas Jefferson, and other patriots enjoyed the game, and Washington and Hamilton had billiard-tables of their own. While Lafayette was in America he played billiards as one of his favorite pastimes, and introduced many French characteristics of the game, which have resulted since in the American game being modeled more after the French than the English. Several inventions have been made in billiard materials during the present century which have greatly improved the game. One is the leather-tip cue, invented by a Frenchman named Mingaud while in prison in 1823, and the same year the cues were imported to the United States. Another improvement was the use of india-rubber cushions for the tables, which originated in England in 1835. In 1854, Michael Phelan, of New York, produced a new style of india-rubber cushion, which with some slight improvements is the cushion in general use to-day. Mr. Phelan's cushion had a sharp edge, while the old-style cushions were round. The first billiard-tables produced in America were made in part of cabinet work, and turned out only as some man of means would order them. About the first tables manufactured as a distinct business were made by Tobias O'Connor and Hugh W. Collender, who formed a partnership in New York in 1850. In 1854 Michael Phelan became interested in the firm, and the title was then changed to Phelan & Collender. Mr. Phelan died in 1871, and Mr. Collender carried on the business under his own name until 1879, when he organized the H. W. Collender Company. With the growing popularity of billiards and the valuable patents held by this company its business rapidly increased, and in order to still further expand, the H. W. Collender Company in 1884 united with the J. M. Brunswick & Balke Company, of Chicago, and the firm has since been the Brunswick-Balke-Collender Company, with factories in New York, Chicago, Cincinnati, St. Louis, and San Francisco, and branch stores in all the principal cities in the United States, and also in Europe and Canada. Of these founders of the billiard-table industry in the United States, Michael Phelan, Hugh W. Collender, J. M. Brunswick, and Julius Balke, all are dead.

The United States now leads other nations of the world in the design and workmanship of its billiard-tables and accessories. American tables are in demand wherever the game of billiards is played, which leads American manufacturers to believe that they will before long supply the world's markets. But while our tables lead, billiard-table cloth used on the tables comes entirely from abroad. The ivory for the balls is, of course, imported. Some of the woods for the tables are imported, but the complete table is manufactured entirely in the United States. There are now $2,000,000 of capital invested in the billiard-table industry. To show the wonders of ivory in its native state the Brunswick-Balke-Collender Company have a fine collection of ivory tusks at their New York salesrooms. There are elephant tusks on exhibition over eight feet long and weighing over 100 pounds each, and also ponderous tusks of mammoths from Mozambique. The finished billiard-balls of ivory have to be carried in a dry room for five to ten years before being fit for use. Nothing has yet been found equal to ivory for billiard balls. The demand for billiard-tables, cues, balls, etc., has increased largely during the past few years with the growing popularity of the game in families.

PIPES AND SMOKERS' ARTICLES

THE manufacture of the more expensive pipes and most other smokers' articles began about 1860. Previous to that time they were imported; but the ordinary clay pipe has been in use for seventy years, if not more. The earliest manufacturer whose name is now recorded was Thomas Smith, tobacco-pipe maker, of the city of New York, in 1847. The high tariff during the war stimulated manufacturing. This was commenced on the smallest possible scale by two or three enterprising German workmen,

now dead, with hardly any machinery or experience. The goods could not be compared with the European product, and they were almost as expensive, even with the high tariff paid on the imported articles. Trade itself previous to the war was very small. Edward Hen, who before 1860 was almost the only importer of note, was known as the pipe man of the United States. His pipe business was less than $50,000 per year. William Demuth, a pupil of the celebrated Edward Hen, began the making of pipes in 1861. The prices of goods before and during the war were twice as high as they are now, and American goods in many instances were not up to the standard of European goods. But now the pipe industry in the United States is not only equal to that at the celebrated factories in Vienna, Ruhla, and St. Claude, but surpasses the latter in many respects. Many improvements and inventions were made in America, which were later introduced into Europe; but it was years before Europeans utilized them, thus giving great help to the American industry, as it afforded still more time to improve, and, with the tariff protection during these years, gave ultimately a still better chance to compete.

The capital then invested could not have been over $150,000, but that now used in this business is over $2,000,000, fully seventy-five per cent. of this amount being invested in domestic manufactures and their products. The sales of smokers' articles will not fall short of $3,000,000. At the prices that were paid thirty to forty years ago this would have represented a value of at least $6,000,000. Machinery, study, enterprise, and protection have enabled the manufacturers here from year to year to reduce the cost of production.

STRAW HATS

THE first straw hats produced in the United States were of the palm-leaf variety, the material of which was imported from the West Indies and braided in this country, about 1800. Mountain leghorn hats were next worn, made from imported Italian material, and they, in time, became fashionable. Maracaybo hats and Panama hats were next manufactured of imported material, and at one time were highly prized, good Panama hats bringing as high as $120 apiece. By 1840 straw braids brought from Italy were shaped into hats, and the production of straw hats received an impetus in which it has hardly slackened since. Straw braids are now imported from Italy, China, and Japan. The straw-hat factories, through wise tariff laws, have had a very rapid growth. They sprang up so fast that it is difficult to tell who were the founders. The first manufacturers of straw goods in America made millinery goods, and from this took up the manufacture of hats. One of the earliest was J. D. T. Hersey, who had a factory at Monson, Mass. Another was Flagg & Baldwin, at Milford, Conn., which has now become Vanderhoef & Company, with several factories; and another was William Knowlton & Sons, who have a large straw-hat factory at Upton, Mass. Other places leading to-day in the manufacture of straw hats are Brooklyn, N. Y., Newark, N. J., and Amherst, Westboro, and Foxboro, Mass. The American straw-hat industry was never so prosperous as to-day, and no other country equals the United States either in quality or in cheapness of straw hats. America sends straw hats to every civilized country in the world.

CELLULOID

CELLULOID has been known since about 1869, having been brought out shortly before by Messrs. John W. Hyatt and I. S. Hyatt, the latter of whom is now dead. It is a compound of guncotton and camphor, which has a high luster, admitting of an excellent finish, and can be used for almost everything for which ivory and horn are employed. Business was begun in Albany in a small way, the inventors characterizing the new product by the name of celluloid. They patented their discoveries and formed the Celluloid Manufacturing Company. Running short of capital, they interested some New York parties with them, among the more prominent of whom were General Marshall Lefferts, Tracy R. Edson,—both of whom are now dead,—Joseph Larocque, and Joseph M. Cook. The business was moved to Newark, N. J., in 1870. The first few years were spent in experimenting and in perfecting the processes, and as soon as this had been accomplished a large business resulted, which has shown constant growth ever since. The original policy of the company was to confine itself to the manufacture of crude material only, and to sell it to sub-companies formed for the purpose of manufacturing special lines of goods under a license from the parent company.

About 1880 a competing company sprang up, which resulted in long and expensive litigation involving the patents owned by the Celluloid Manufacturing Company, the decisions finally being rendered in favor of the latter company. As a result, in 1890, a consolidation of the different interests

was brought about by the formation of the Celluloid Company, which purchased the plants and other properties of not only the companies competing in the manufacture of the material, but also of the principal sub-companies. The actual amount of capital invested at that time probably did not exceed $25,000. As the business grew more capital was invested from time to time, until now the company is capitalized at $6,000,000, employing about 1500 hands directly in its manufacture, besides selling the raw material in the form of sheets, rods, etc., to a large number of manufacturers throughout the country, who probably employ some 4000 or 5000 hands in working it up into goods. It is impossible to state the annual out-turn of the goods, owing to the fact that it is scattered among so many manufacturers; but it runs into a number of millions of dollars per annum.

BROOMS AND BRUSHES

"A NEW broom sweeps clean" is a saying which experience has proved true; but the old adage could never have been fully appreciated until the production of American broom-corn brooms. Europeans use to this day a broom made from hickory withes for rough sweeping, and the long-haired brush for housework, and it was not until 1850 that Americans discovered the valuable properties of a variety of the indigenous Indian maize for broom making. An unknown farmer who used a tuft of corn for a brush was, tradition tells us, the unconscious inventor of corn brooms. The first factory established for the manufacture of brooms from corn was in 1859, by Ebenezer Howard, at Fort Hunter, Montgomery County, N. Y. Before that time the industry was carried on in a desultory way. Mr. Howard subsequently took his son in partnership, and the firm became E. Howard & Son, continuing in business for forty years, when it became a part of the American Broom and Brush Company, in November, 1894. Other broom factories were soon started in Fort Hunter by John D. Blood, who formed the firm of Blood & Herrick, and also by Ebenezer Howard, who formed another firm, Howard & Bronson. All of the broom factories established at Fort Hunter have since become absorbed by the American Broom and Brush Company, and are all in operation to-day, with the improved machinery which has come with time. Another old-time factory which was acquired by this company was that of Myers & Parker, at Fultonville, N. Y. Of the pioneers in broom making at Fort Hunter all are dead except Mr. Herrick, who has retired from business and lives at Amsterdam, N. Y. The broom and whisk-broom industry is now carried on in the Eastern States almost entirely by the American Broom and Brush Company, which, besides the factories named, also have works at Buffalo, N. Y., Dallas, Pa., Baltimore, Md., and Richmond, Va. The business in the Western States is in the hands of the Cupples Woodenware Company, of St. Louis, and Roseboom & Company, of Chicago. All of the brooms are now turned out by machinery which is entirely of American invention, and which enables the manufacturers to produce 3,000,000 dozen brooms annually, supplying the home market and exporting $250,000 worth as well. There are now $2,500,000 invested in the industry, while twenty-five years ago there were only $100,000, and fifty years ago none whatever.

Many brooms are made by hand in various penitentiaries throughout the country. There are also many brooms made in blind asylums, as the work is found especially adapted to blind men. The United States is particularly fortunate in having so much territory adapted to the cultivation of broom-corn, which requires a certain quality of soil and climate. The only place where broom-corn has been cultivated to any degree of success outside of the United States is on a narrow strip of land in Upper Italy, but the corn is of an inferior quality. In this country broom-corn flourishes in Kansas, the southern part of Nebraska, a strip of land in Oklahoma, one portion of Illinois, and a narrow strip of land in Tennessee. A little broom-corn was once raised in New York State, but this has given way to other crops.

BUTTONS

BUTTONS are among the small things of daily use the importance of which as industrial factors is out of all proportion to their size. It is now estimated that there are from $8,000,000 to $9,000,000 worth of buttons made in the United States every year, and that there are from $4,000,000 to $5,000,000 invested in the industry. The manufacture of metal buttons was the first branch tried in America, and dates back to 1802, when Abel Porter & Company opened a shop at Waterbury, Conn. The firm has since become, through the successive management of Leavenworth, Hayden, and Scovill, the Scovill Manufacturing Company, and is now a large corporation, manufacturing brass goods and making buttons as well. The second American button factory was established at Waterbury by Aaron

Benedict in 1812, for the manufacture of bone and ivory buttons. In 1823 Mr. Benedict became associated with Bennett Bronson, and they took up the manufacture of gilt buttons also. At this time there was no sheet-brass rolled in America, so the firm erected a brass-rolling mill to supply their button business. In 1849 the button industry was put by itself, and has since become the Waterbury Button Company, the largest firm engaged exclusively in the manufacture of metal, cloth, and ivory buttons in the United States.

The founder of the cloth-covered button industry was Samuel Williston, of Easthampton, Mass., who, with his wife, in 1825, made the first set of cloth buttons ever produced in America. In 1830 Mr. Williston formed a partnership with Joel Hayden, and together they built a button factory at Haydenville, Mass., Mr. Hayden being the mechanic and Mr. Williston the proprietor. In a few years the business was moved to Easthampton, and has since become the Williston & Knight Company. In 1859, A. Critchlow, an Englishman, began to make buttons from vegetable ivory at Leeds, Mass., and subsequently became connected with the Williston & Knight Company, which has continued making a great variety of cloth and ivory buttons ever since. All of the pioneers of the American button industry are now dead.

In the manufacture of pearl buttons, which are a most expensive kind, America has not done much until late years. The Newell Brothers Manufacturing Company, of Springfield, Mass., was one of the first firms to begin it. This company was established at Longmeadow, Mass., in 1848, by Nelson C. Newell, his brother, S. R. Newell, and D. Chandler. The firm has always made a great variety of buttons, including cloth-covered, vegetable-ivory, composition, india-rubber, and pearl buttons. Of the hard buttons, vegetable ivory is one of the principal materials, as it can be dyed any color and makes a hard, durable button. Composition buttons have come into use largely of late years, while cloth-covered and pearl buttons are always in demand for dress-wear.

Button making is an industry in which the cost of production is in large part labor, so that, with the high wages paid in America in the face of foreign competition, it has not reached the proportions of some other industries. Despite this it is estimated that ninety per cent. of the cloth buttons consumed in the United States are of domestic manufacture, and a like percentage of the brass buttons. This showing is made when all of the material of cloth-covered buttons—even the iron backs—is imported, and also the raw material of pearl and vegetable-ivory buttons. It is American machinery and a tariff duty that gives American manufacturers a chance to compete with the cheaper European labor. In brass buttons a vast number of styles and designs have been produced in this country, one firm alone making 5000 varieties of army, navy, railroad, and other uniform buttons. The styles of cloth buttons are mainly taken from France and England and improved upon here. The Eleventh Census reported 106 establishments engaged in making buttons, and turning out an annual product valued at $4,216,795.

OPTICAL GOODS

Until thirty-five years ago America depended on Europe for its eye-glasses and spectacles. Now the United States furnishes its own optical goods and sends some to the rest of the world as well. The first American manufacturer of eye-glasses is said to have been a New-Englander named Salsbury, who ground lenses in a small way at Salsbury, Conn. He was followed by the firm of Brown & Kirby, of New Haven, Conn., in 1850, and then the manufacture was taken up and developed by J. E. Spencer, who established works in the same city. Other optical works have since been built throughout the country, until there are now about $4,000,000 of capital invested in the business, with an annual output equal to this amount. That the industry should have grown to such proportions is natural enough when the number of people wearing spectacles is considered. It is common practice nowadays to have one's eyes examined. Twenty-five years ago there was but one noted oculist in New York City, Dr. C. R. Agnew; to-day there are hundreds. The fine print of newspapers, the custom of reading while on moving trains, and the glaring lights of modern times tend to the benefit of the oculist and the optician.

The mode of making eye-glasses has entirely changed with the requirements of the times. Properly fitting lenses are now ground from an oculist's prescription. In fact, it is seldom now that eye-glasses are made in any other way. This is one of the improvements that has come with American manufacture, for before the home supply, importations were made of assorted lenses, but accurate adjustment to the eyes was not possible as it is to-day. To further illustrate how the industry has advanced it is interesting to note that thirty years ago the Spencer optical people made but one style of nose-piece; to-day they make over 700. French

and German goods are the only competitors now with American eye-glasses and spectacles, and even then in but a very moderate degree. In the department of lenses for telescopes and microscopes the United States now manufactures its own. The firm of Bausch & Lomb, of Rochester, N. Y., are noted for microscopes, and Alvan Clark, of Cambridgeport, Mass., is famed for the grinding of mammoth telescope lenses. Opera-glasses still come from across the water, mainly from France.

MATHEMATICAL AND ENGINEERING INSTRUMENTS

As the American optical industry has grown and expanded in the last twenty-five years, so has it been in the manufacture of surveying and mathematical instruments in the United States. The industry first sprang into existence through repairs, and then in making instruments to order, and finally the regular instrument factory came, until it is now estimated that there are over $5,000,000 capital invested in the industry. One of the first to make American instruments was the firm of William Stackpole & Brother, who opened a shop in New York some thirty years ago, and have made all kinds of surveying, navigation, and drawing instruments ever since. Other shops were opened in Boston and Washington, and gradually some of the instrument importers started factories of their own. One of these firms is the Keuffel & Esser Company, of New York, which has built a large factory at Hoboken, N. J., and has salesrooms in nearly all the larger cities of the country. America now manufactures all of its own instruments, and sends many to foreign lands.

SURGICAL INSTRUMENTS

Surgical-instrument manufacture in America began, so far as learned, in 1826, when George Tiemann, a German, commenced to grind, repair, and make instruments in New York City. Prior to that time all surgical appliances were imported from England and France. Germany is the greatest competitor of the United States in this direction to-day. The industry in the United States has flourished solely on its merits, for skilled labor enters so largely into the cost of surgical instruments that this country has not been able to hold its own with the cheap grade of instruments of foreign makers. It is to quality, not quantity, that American surgical-instrument makers have turned their attention, and in firmness, lightness, and durability of their wares they have no equals. American surgeons are noted as practical men with original ideas who have invented and have required of the instrument makers a great variety of surgical appliances. There are many new designs being brought out continually, and, with constant changes required and keen foreign competition in cheaper but inferior lines of goods, surgical-instrument making has not become a large industry here. The pioneer of the business in this country, Mr. Tiemann, established the firm of George Tiemann & Company, which has been in successful operation for sixty-nine years. Among other large American manufacturers of surgical instruments are Shepard & Dudley, of Brooklyn; John Reynders & Company, of New York; and F. G. Otto & Sons, of Jersey City. Another old-time New York maker is W. F. Ford. A number of American firms have gone out of business of late years, being unable to withstand the cheap goods of foreign manufacturers. Quantities of instruments are now imported from Germany, but for high-grade surgical instruments American surgeons turn to American manufacturers.

SCALES AND BALANCES

The weighing-scales, which to-day form one of the most useful adjuncts in almost every commercial house, public market-place, and town square in the land, are the product of American genius alone. The first platform-scales ever made were invented and patented by Thaddeus Fairbanks, of St. Johnsbury, Vt., in 1831. Before that time transactions by weight were confined to the even balance and the Roman steelyard. Mr. Fairbanks was associated with his two brothers in a small business in which quantities of hemp were handled. Finding the method of weighing by the steelyard slow and laborious, he conceived the application of the principle upon which modern weighing-machines are made, and from this beginning sprung the use of platform-scales in all parts of the world. The manufacture of these scales was then commenced by E. & T. Fairbanks & Company, who have made them ever since and have introduced them in all parts of the world. At an early date the Fairbanks patents were sold in England, and most foreign platform-scales are made from the earliest patterns manufactured in the United States. Before the introduction of these improved weighing-machines, comparatively few articles were sold by weight, and those only of such a nature that to count or measure them was very difficult, while at present nearly every class of merchandise is sold by weight. This revolution

in commercial usage has not been confined to the United States, but has taken place in almost every country of the world; and the Fairbanks scales have in many instances been the pioneer articles of American make to be introduced into foreign countries. In recognition of these services, Thaddeus Fairbanks was knighted and decorated by the Emperor of Austria and other foreign sovereigns.

Among the other pioneers in the scale business was Mr. John Chatillon, who began business in New York in 1835. Mr. Chatillon's business has been confined almost entirely to the making of spring-balances. The industry he built up is still conducted by his sons on a part of the original site of the factory. The manufacturers of scales in the United States successfully compete with foreign makers in the markets of the world. Weighing-machines produced here are the recognized standards of foreign countries. They include every known variety, from the delicate mechanism of the laboratory to determine the weight of infinitesimal objects, to the ponderous levers arranged to weigh a loaded train of cars or a canal-boat with its cargo. There are now $2,500,000 capital invested in the manufacture of scales in the United States, and the annual production, according to the last census report, was about an equal amount.

PENS

It has been declared that each man, woman, and child in the United States uses, on the average, four pens a year. The same authorities also say that three of these four pens are of American make. Some idea of the growth of the pen industry may be obtained, therefore, when it is known that thirty years ago nearly all the pens consumed in this country were of foreign manufacture. The first pens made in the United States were those turned out by a small factory established in New York in 1858 by Harrison & Bradford. At that time America possessed neither the men nor the material for making pens, and both had to be brought from abroad. In 1860, Richard Esterbrook, his son Richard, and James Bromgrove founded a pen factory at Camden, N. J. The business was a success from the start, and in 1866 the firm was incorporated as the Esterbrook Steel-Pen Company.

Steel from which pens can be made has not yet been produced in this country. Manufacturers are unable to say whether the trouble lies in the handling of the steel or in the material itself. The steel must possess a fineness and toughness that has thus far been found in the products of England and Sweden only. Pens, therefore, can be made in England more cheaply than in the United States; but in foreign countries, where a greater amount must necessarily be charged for the American article, the latter finds a ready market, despite the fact that it must be classed as a fancy article. Twenty-five years ago not more than $10,000 were invested in the pen industry, while to-day the combined capital of American manufacturers is more than $1,000,000. Besides the Esterbrook Company, prominent pen manufacturers in the United States are Miller Brothers, Meriden, Conn.; Turner & Harrison and Malpass & Company, Philadelphia; and the Eagle Pencil Company, New York.

PLAYING-CARDS

The origin of playing-cards is shrouded in mystery, and of their manufacture in the United States we have few records prior to 1832. Though history tells us that Columbus carried them with him on his voyage of discovery in 1492, certain sections of the American colonies prohibited the entrance of cards into the country. The Quakers of Pennsylvania were shocked at them, and the Puritans of New England called them "devil's books." But in other parts of the country playing-cards have found favor as simple instruments of amusement, and nowadays they are generally used. In July, 1832, Lewis I. Cohen, of New York, entered into the business of card making, and started the concern which is now known as the New York Consolidated Card Company. Mr. Cohen made the first pack of cards himself, which is still preserved at the company's works in New York. For a long time the Consolidated Company was the principal card producer in the United States, its only competitors being a few small manufacturers.

Another old-time card maker was Andrew Dougherty, of New York, who is still in the business. In 1879 the Russell & Morgan Company was started at Cincinnati, and in 1889 the National Company at Indianapolis, for the manufacture of playing-cards. The Russell & Morgan factory was in 1893 reorganized under the title of the United States Playing-Card Company, which is now the largest producer in the United States, and with the Consolidated Card Company manufactures nine tenths of the total American card output. This now amounts to 25,000,000 packs of cards annually.

Playing-cards are at present nearly all made with enameled paper by improved machinery, and printed

by rapid-working presses. The United States exports cards to nearly every country in the world, besides supplying the entire home demand. It is calculated that there is not now over $700 worth of cards imported into this country a year, while the only countries to which America does not send cards are those in which the government controls the business, as in France and Italy. The United States Playing-Card Company has even established an office in London. There is at present an internal revenue tax of two cents on each pack of cards used in the United States. The capital invested in the industry is $5,000,000.

TOYS

During the first half of the present century young America's toy supply came entirely from across the water. Germany, which is even to-day the great toy country of the world, supplied the larger part, and Japan also a share. About 1850, however, several toy-shops started in a small way in the United States, and, as in nearly all the industries, Yankee ingenuity has since put this country in the front rank of toy makers. One of the first to devote his attention to the business was John McLaughlin, who with his brother established the firm of McLaughlin Brothers, in 1855, at New York, makers of children's picture-books and games, which are considered a part of the toy business. Another pioneer was Milton Bradley, now treasurer of the Milton Bradley Company, at Springfield, Mass., makers of games and kindergarten supplies. Both firms are successfully carrying on the toy business to-day. America, being a forest country, soon began producing wooden toys of grades which could be turned out by machinery. In the manufacture of these wooden toys the United States had an advantage, as Europe had but little wood and worked mostly by hand, while America had an abundance of wood and her inventors were always perfecting machines to do the work. Then, also, wooden toys were bulky to import. But the principal advantage of the American wooden-toy manufacturers was in the wonderful woodworking machinery, certain patented forms of which even the Germans have found it necessary to buy in order to keep abreast of their American rivals. All the wooden toys used by young America which can be produced by machine-work are now of domestic manufacture, and large quantities are also sent all over the world. The wooden-toy factories are in no particular section of the country, but are found in nearly all of the wood-bearing States.

A branch of toy making which may be classified as distinctively American is that of iron toys. Messrs. J. & E. Stevens, of Cromwell, Conn., were among the first to take up this branch. Iron toys are now made into an amazing variety of forms, and many of the designs have been copied by foreign manufacturers. The making of musical toys is another part of the business which has become prominent in the United States. Schoenhut & Company, of Philadelphia, make nearly all the musical instruments in miniature sizes, even including toy pianos. Mechanical toys, with their clockwork and fascinating movements, have likewise flourished in the United States, but there is not a great demand for this class at present. Toy tools are another of America's chief productions. The toy business is of such a nature that it is continually changing, both in respect to the goods and the firms engaged in it. Novelties and fresh inventions drive out old styles very speedily, and unless a manufacturer keeps well up with the times he will be out of the race. The growth of the toy industry has led to the establishment of several toy emporiums in New York City and elsewhere. Among the oldest toy merchants in New York are the Hinrichs Company and Robert Foulds. The returns of the last census place the number of establishments in the United States engaged in the manufacture of toys and games at 139, employing 3440 hands, and turning out an annual product valued at $3,749,755.

YACHTS—SAILING AND STEAM

The small speedy vessels which the Dutch called yachts were familiar in the waters around Manhattan Island before they were known in England. But yachts in the modern meaning of the word have been evolved during the last half-century. In no other country are there so many yachts and yachtsmen as in America. There are more than 200 yacht clubs scattered throughout the country, having about 4000 yachts. But of these vessels only about 700 are above 40 feet in length, and only a little over half of these are propelled by steam. The New York Yacht Club, the oldest in the United States, having been organized in 1844, has a membership of over 1000, but there are only about 140 steam yachts and launches on its list. Thus the small sailing yacht is the normal type of American pleasure craft. There are two distinct kinds of yacht, whether propelled by sail or steam—the racing yacht, in which comfort is sacrificed for speed, and the commodious, well-proportioned cruiser yacht; but

even in the latter every modern discovery tending to increased speed is incorporated.

Popular interest in yachts may be dated from the victory of the yacht *America* in the international contest around the Isle of Wight in 1851. She represented certain American ideas in the shape of her hull and the fit of her sail, which were immediately copied in England. From that day to this the history of sailing yachts has been a steady improvement in speed through the efforts of such yachtsmen as James Gordon Bennett, General Charles T. Paine, C. O. Iselin, J. Pierpont Morgan, and William K. Vanderbilt, and such designers as the late Edward Burgess, A. Cary Smith, J. Beaver Webb, formerly of England but now of America, and Nat G. Herreshoff. The last-named designer was the author of both the latest international cup-racers, *Vigilant* and *Defender*. The same designers have won golden opinions for their work in the field of steam-yachting, as have also Gustav Hillmann, Lewis Nixon, C. D. Mosher, and Charles M. Seabury; and American yards can now turn out steel steam-yachts equal to the best made in England.

BOATS, CANOES, AND SHELLS

Though America is the home of the famous birch-bark canoe, the modern sailing canoe was developed almost entirely from English and Canadian models. The birch-bark canoe is still used on some of the inland waters, but it has been largely superseded by the modern wooden type, which was introduced in the United States from England about 1863. The first canoes built in this country, following those of Indian manufacture, were constructed by individual boat builders. Among the early canoe builders was James Everson, who began to build them from English models at Greenpoint, N. Y., in 1869. Another was Davis, an Englishman, who built fine canoes at Ithaca, N. Y., in 1871. From these and other early canoe builders regular companies have been formed to build canoes and skiffs. One of the large and successful corporations is the St. Lawrence River Skiff, Canoe, and Steam-Launch Company, founded by Charles G. Emery, John D. Little, and J. G. Fraser, in 1887, at Clayton, Jefferson County, N. Y. Another large builder is J. H. Rushton, of Canton, N. Y.; and among the celebrated builders of sailing canoes for racing are Captain G. W. Ruggles, of Charlotte (Rochester), N. Y., and Stevens, of Lowell, Mass. In the building of row-boats and small sail-boats the United States turns out as fine models as any nation, but no records are obtainable of the early history of the industry. The boat-construction industry is so widely scattered throughout the country that no figures can be given of its annual output, but it must be very large.

One class of boats in which the United States takes undisputed precedence is in the construction of naphtha-launches, first patented in the United States. The Gas-Engine and Power Company, of Morris Heights, New York City, has the American rights for the naphtha-engine, and in 1885 Jabez A. Bostwick, Clement Gould, and John J. Amory established this industry on the Harlem River, New York City. At the World's Fair in Chicago in 1893 the General Electric-Launch Company, of New York, had fifty electric launches running in the waters of the lagoons, and the spectacle was one of the features of the fair. The American electric launches are probably destined to have as brilliant a future as the naphtha-launch has had.

The manufacture of racing shells has rather disappeared as an industry of itself in the United States; the demand is limited and the most of those constructed are made to order by boat builders who are also shell experts.

PINS

Pins were made in Rhode Island during the Revolution by Jeremiah Wilkinson, the heads being made by twisting fine wires firmly at one end. Samuel Slocum at about the same time commenced in Providence in the same line. In 1824 a machine for making solid-headed pins was invented by Lemuel W. Wright, of New Hampshire, which was soon after introduced into England, patents also being granted there. It was, however, crude compared with those of later construction, and did not complete all the operations of pin making. In 1831 the first machine for making perfect solid-headed pins like those now in use was invented by John Ireland Howe, a physician of Bellevue Hospital, New York City, and in the next year a company was started in that city. Six years later the business was removed to Derby, Conn., where it is still carried on. Associated with Dr. Howe was Mr. Fowler, of Seymour, Conn., who was the inventor of several machines for sticking pins on paper. In 1835 another company was formed by Dr. Howe, which continued its operations under his charge till 1865, many improvements being made. Samuel Slocum, an ingenious Connecticut man, also invented a pin-sticking machine, which was used in Howe's factory in 1841, and was improved in 1843, he and Mr. Slocum becoming

joint owners of the two patents. The United States takes the lead in the production of superior machines for use in the manufacture of pins. The number of pins made daily is probably about 30,000,000, or nearly 10,000,000,000 per annum—enough to allow 150 pins per year to each man, woman, and child in the United States. The chief place of manufacture is Connecticut.

COOPERAGE

If Africa is the hunter's paradise, America is certainly the joy of the cooper, for no other country has possessed such boundless forests of oak, from which the bulk of the barrels are made, and no other nation has produced such ingenious cooperage machinery. The quantity of timber cut up every year in the United States for barrels, casks, and staves has been such a steady drain on American forests that barrel manufacturers are beginning to apprehend a scarcity of oak and are buying up large tracts of forest land to prepare for the future. The Canadian forests are already depleted of oak, and so are those of some of the Western States, the main supply now coming from the South. The scarcity of timber, however, has not yet made an impression on the barrel market, for barrels and casks of all kinds are as low in price as they have ever been, and the number of barrels manufactured for home and foreign needs is as enormous as ever. Barrel making in the United States is supposed to have begun with the early settlement of the country. Everything was at first done by hand, while now all are made by machinery. One of the first machine barrel manufacturers in the United States was Anson T. Briggs, of New York, who manufactured flour-barrels in quantities along in 1860. Staves were turned out by machinery as early as 1855, but the first manufacturer to use machinery for cooperage was George S. Salter, of Baltimore, in 1869. He was followed a year later by Lowell M. Palmer, of Brooklyn, who is now president of the Brooklyn Cooperage Company, and who began making barrels in 1865.

The introduction of machinery in cooperage met with headstrong opposition from the coopers, and Mr. Palmer had a strike at his works, which lasted for four months before the men could be convinced that they could earn more money by the use of machinery than with the old hand methods. This was proved by Mr. Palmer, who for one year from the time of the introduction of the machinery gave the coopers in his employment fifty cents more a day than they had previously. The Brooklyn Cooperage Company now turns out 35,000 barrels of all kinds a day in its factories at Brooklyn, Jersey City, Boston, New Orleans, and San Francisco; while other manufacturers also produce enormous quantities. The staves are sawed out at the timber-mills and shipped to the cooper-shops in this country if the barrels are for domestic use, while quantities of staves are also shipped to foreign countries to be made up into barrels. No material has been found equal to oak for casks, while for sugar and flour barrels elm is employed. The barrel has always been a popular means for transporting produce and merchandise in America, and its handiness is also appreciated abroad, so that the production is now valued at $38,617,956 annually, which supplies the United States and a large part of the rest of the world with barrels, casks, and staves. The number of establishments is 2652; the number of employees, 24,652; the amount paid out for wages each year, $11,665,366; and the cost of materials used, $20,636,911.

LAMPS

When the Pilgrims landed they had no other lights than those which were afforded by candles and whale-oil. The former required candlesticks, and the latter, lamps. A temporary lamp was made by filling a dish with oil, while on it floated a piece of wood through which passed a wick. Torches and temporary lights were afforded by pine knots. Both candlesticks and lamps were occasionally made in ornamental forms, but the light was always poor. Even theaters could be lighted in no better way than by candles. No radical improvement was shown in the construction of lamps until 1784, when Aimé Argand, a Frenchman, conceived the idea of a circular wick and a double wick-tube, thus obtaining a round flame. Air was admitted both inside and outside, thus insuring a more perfect combustion. Around this wick he placed a glass-chimney. But these lamps were used only in the houses of the rich, and tallow candles remained the ordinary illuminant for all others. In the first quarter of the nineteenth century, at which time whale-oil was very cheap, moderate-priced oil lamps came into use. They were composed of a closed reservoir for holding the oil, and two small, round tubes through which the wicks were passed. On the sides of these tubes were two small slots through which the wicks could be picked up.

In 1845 the camphene or burning-fluid lamp became prominent. These were two different kinds

of oil obtained from turpentine and alcohol, but giving a much brighter light than candles. The lamp in which these oils were burned was also much cleaner and neater. This lamp had two round wick-tubes, to which two small caps were attached, to be placed over the tops when the lamp was not in use, in order to prevent the evaporation of the camphene, which went on very rapidly if measures were not adopted to prevent it. About 1856, when petroleum was discovered in Pennsylvania, lamps were made for its use; but there was considerable smoke from them, and the oil had a very pungent odor. There were, consequently, but few lamps made especially adapted to this product; but as soon as the unpleasant odor had been eliminated to some extent and the price of oil became lower, kerosene lamps were introduced everywhere. Many, however, still continued to burn camphene in 1860 and 1861, and did not stop until the war, which, by preventing the receipt of turpentine from North Carolina, raised the price of camphene so high that people turned to petroleum. At that time an ordinary camphene lamp gave twice as much light as a tallow candle, and a kerosene lamp six times as much. Lamps for whale-oil were occasionally used till the same time, but this oil bore no comparison with the mineral product for cheapness, and was also driven out of the market. The light obtained from it was about equal to that from tallow candles.

Since 1862 there has practically been no other lamp used than the one just spoken of. It was fitted with a flat wick, and required a glass chimney, although from time to time since some lamps have been made without chimneys. Many patents have been granted for improved lamps, the most valuable of which have been for a central draft. Duplex burners were a great improvement, and Argand burners and chimneys were also used. The latter were employed in what are known as student lamps. The metal button or flame-spreader was also introduced, and it is still employed in central-draft lamps.

Mr. Leonard Henkel, of Rochester, N. Y., invented a few years ago what may be said to be a distinct improvement in the lamp. The contrivance consists of a small cap placed over the top of the central-draft tube, the sides of the latter being filled with holes, thus permitting the air to pass through the tube up to the flame.

These various improvements have resulted in lamps which are far superior in power and steadiness of light to those formerly known. If the power of an ordinary petroleum light is taken at six times that of a candle in 1858, the larger lights had increased to 20 candle-power in 1868. But the more recent improvements have raised this in ordinary parlor lamps to 60 or 80, and in hall and church lamps to 200 and beyond. They are also less troublesome and give a better kind of light. A large trade is carried on in them. In one city alone the manufacture is carried on to the extent of $400,000, and the value of the annual product of lamps and reflectors, as reported by the census of 1890, was $4,039,359.

LAMP CHIMNEYS

The idea of having a glass tube around the flaming wick of a lamp belongs to Aimé Argand, as has been said. It prevented cold air from directly impinging upon the flame at the sides, it greatly assisted the draft, and it acted as a shield against currents of air. Wherever Argand lamps were afterward used, a chimney was required, but none seems to have been made in this country till 1856, at Pittsburg. At about that time chimneys were required for coal-oil lamps, which smoked very much without them. With the increase in demand for them, other factories began, and new methods of making were introduced. Very few chimneys made in the first ten years of the beginning of the petroleum industry lasted any length of time, the unequal contraction and expansion made by cold and heat breaking them by dozens on the same lamp in one year. The later methods have much improved either the chimneys or the methods of lamp construction, so that each chimney lasts for a considerable time, and occasionally one may be found that has been employed for two or three years. In 1875 there were thirty-one concerns engaged in the manufacture of glass-chimneys, and while at the present time there are but twelve, the price of chimneys has been greatly reduced, and the number manufactured largely increased, the annual output being about 750,000 boxes. Pittsburg is the center of this industry.

BOX MAKING

Box making has now become a considerable industry, particularly in those cities largely engaged in distributing manufactured goods, such as New York and Chicago. In the early part of the century packing-boxes were made by carpenters as they were required, or by any persons possessed of a little mechanical skill. But with the development of the dry-goods industry it was found necessary to

have them made regularly, in large numbers, and in the forms and shapes desired. This required special kinds of boards and construction, and it was found they could be more cheaply bought than made. It was about 1840 before there were many firms thus engaged, but the number has been increasing ever since. The introduction of machinery for sawing, assembling, and nailing the boxes has much increased the facility of manufacture, as mechanical gauges determine the length of each piece, and saws divide a dozen or twenty boards at once. The total amount of business done in this line is about $20,000,000 a year, New York and Chicago each producing about $3,000,000 worth of packing boxes. The capital required is about $4,000,000, and the number of hands employed is 8000 or 9000.

FIREARMS

The rifle, originally invented in Leipsic in 1498, was first brought into general military use in America during the Revolutionary War. The riflemen in Kentucky, Tennessee, and the other wildernesses of the United States had long been accustomed to the use of this firearm, and so far as they could be procured, rifles were the arms of the American soldiers in that struggle. In 1813 G. H. Hall proposed a new idea. He suggested that the rifle be loaded at the breech, so that the ball and powder, united in one cartridge, might be inserted without delay, and the piece loaded and fired as rapidly as the muzzle-loading smooth-bore. Hall's idea did not attract much attention in the United States. The army, for the most part, was supplied with flint-locks, and it would have involved considerable expense to change them all over. He also proposed to manufacture the locks and other pieces of the guns by machinery, so as to make the parts of the different guns interchangeable. He was employed at the government armory at Harper's Ferry to introduce the latter idea and experiment with the former. In this he was successful, and the interchangeable system was soon introduced into all the armories of the United States. In 1827 100 of Hall's guns which had been sent to Springfield in 1824 were brought back to Harper's Ferry and placed with 100 guns of current make. The 200 were taken apart, the pieces thoroughly mingled, and the guns then remounted from pieces picked up at random. The whole 200 fitted perfectly. They attracted much attention abroad, and England afterward obtained machinery in the United States, so that she might introduce the system in her factory at Enfield. Prior to 1853 every gun made in England was manufactured by hand. The percussion-cap was proposed by Shaw, of Bordentown, in 1817, and was really an indispensable part of any improved system of firearms.

The principal weapon of a new type brought out a little before the Mexican War was a purely American invention, namely, the repeater. Samuel Colt, a seaman, while on a voyage to Calcutta, devised a six-barreled revolver to be used with percussion-caps. In 1835 he improved upon this and perfected a six-barrel rotating breech. Prior to this there were two common types of pistol: one the small pistol, suitable for use on a small object at thirty yards; and the other the large horse-pistol, which was almost equal to a gun. Patents were issued to Colt for his revolver, and the manufacture commenced in 1835 at Paterson, N. J. He later built a factory at Hartford, Conn., and turned out 60,000 weapons a year. The large sales brought many competitors into the field, including the manufacturers of the Allen, Derringer, Volcano, Pettinger, Whitney, Smith & Wesson, and Lowell. The pistol was very much employed during the war, and many are even yet sold. Hall's idea of a breech-loading rifle was never put into general use, but in 1852, Stark, of Philadelphia, invented a breech-loading rifle that met with great success. He built a factory at Bridgeport, Conn. The first of a new class of rifles to come into notice was the Spencer, the chief idea of which was applied to other American guns. This was a repeating rifle, but was almost too heavy to be successful. It was too great a burden for the men to bear in addition to their other accoutrements. The Remington, which has acquired great success, is produced at a factory at Ilion, N. Y., founded in 1825 by Eliphalet Remington. One great cause of the growth of the industry was the War of the Rebellion. The capital invested in 1840 did not exceed $200,000; in 1870 it was over $3,000,000, while at the present time it is about $10,000,000. The annual output of rifles is 1,000,000, and the same number each of shot-guns and revolvers. The United States takes precedence in the manufacture of sporting rifles, metallic ammunition, and revolvers.

FIRE EXTINGUISHERS

Fire extinguishers have now been regularly manufactured since 1867, but attempts were made years before that time to devise something which, on its receptacle being broken or the contents poured

out, would prevent combustion. Those who were associated at its inception as a regular business were Dawson Miles (now dead), B. F. Jacobs, F. W. Farwell, and S. F. Hayward. The places where factories were earliest established were in Boston and Chicago. Small hand-extinguishers were first made, but now the size has so much increased that the production includes large engines drawn by horses. The total of manufacture is about $150,000.

GLOVES AND MITTENS

The glover's art is centuries old in Europe, but its beginnings in this country are almost or quite within the memory of men now living. Mittens were not unknown to the Indians, and the earliest settlers in the country made for themselves rude hand-covers from the skins of wild animals; but glove manufacture as an American industry is only about sixty years old. A Vermonter named Burr was among the earliest to establish it, at what is now the city of Gloversville, N. Y. Deer were plenty in the neighboring forests, and their skins were the chief material used. The early products were no doubt quite crude, but they sold and their sale was profitable.

For many years deerskin, usually called buckskin, was the only leather thought to be suitable for a driving or working glove. Sheepskin was used, but it was weak and pulpy. Two or three towns in New Hampshire attained a good reputation for buck gloves, and in later years factories have been established in various parts of the country, notably in Illinois, the Northwest, and California; but the chief seat of the industry is at Gloversville and Johnstown, Fulton County, N. Y.

Buckskin remains the preferred material for heavy gloves, and varies much, from the thick "jack" hide of the torrid zone to the thin, tough cuticle of the Rocky Mountain deer. Other leathers are approved. Sheepskin is now so dressed as to make it durable in all weathers, and the equine, bovine, and porcine hides are all valuable for hand-wear purposes of the rougher sort. Genuine dogskin is made up by a few firms, the stouter skins entering the above category, while the finer ones may do for street wear.

For the purpose last named many skins are utilized. Among them are the goat, kid, lamb, antelope, calf, colt, Egyptian sheep (mocha), and cabrita or South American kid. Chamois is sometimes used. The best castor gloves are made from antelope. Coltskin has a fine surface and wonderful durability. Mocha and cabrita resemble castor, having a velvety finish. The former has the grain-side outward, while the latter reverses that order. Goat, lamb, and kid are the staple leathers for street and dress purposes. Reindeer has been added in recent years, and makes a good street glove.

Kid and lamb skins dressed are extensively imported to be made up here; but these and all the other kinds are also brought in a raw state from all over the earth, to be made into glove-leather in the scores of tanneries in Fulton County, New York.

The manufacture of the finer classes of gloves—kid, castor, etc.—in the United States is hardly twenty years old, but within that time great progress has been made. In fact, the last five years have been a period of rapid growth. Formerly it was thought necessary to label domestic gloves with foreign brands, but it is not so now. The importations of gloves of European make are still large, owing to the excellent reputation of some lines and the extreme cheapness of others; but probably four fifths of all the leather gloves used in this country are of home manufacture.

Considerable development has taken place of late years in knit gloves of wool and silk. What are known as Scotch-wool gloves have become popular, and our manufacturers have shown much ability in matching the foreign product, excellent as it is, with creditable goods at low prices. Silk gloves of high merit are made here, and several new factories for this purpose have recently been started. The total value of the American glove manufacture is probably well above $10,000,000.

ENVELOPES

Envelopes were not in general use in any country prior to 1840, when, after the passage of the penny postage bill, they became common in England. Until about 1845 nearly all letters in this country were folded so that an unwritten portion came on the outside, and the address was placed there. By that time envelopes were well known, and by 1850 all letters were inclosed in them. The first maker of envelopes in New York was an Englishman named Dangerfield, who began about 1846; and by 1850 Alderton and several others were in the field. Only 2000 or 3000 could be made in a day, as machinery had not yet been employed. The blanks were cut out by chisels and pasted and folded by hand. Machines were invented in England in 1845 by Warren de la Rue and Edwin Hill, but these were never employed in America. Our

machinery was invented here, but not until just before the outbreak of the Civil War. Many improvements have been made, and the speed is now so great that on some of the machines the output will reach 55,000 a day. It is supposed that the consumption of envelopes in this country is from 8,000,000 to 10,000,000 a day, or not far from 3,000,000,000 a year, of which 600,000,000 are stamped envelopes. The latter are all supplied by the Morgan Envelope Company, of Springfield, Mass., and the Plimpton Manufacturing Company, of Hartford, Conn. There are about thirty large firms engaged in the business, besides a number of smaller manufacturers. The principal towns thus employed are New York, Philadelphia, Hartford, Rockville, Holyoke, Worcester, and Springfield.

AMMUNITION

AMMUNITION may loosely be defined to be the articles which are required in firearms to render the mechanism effective. It includes shot, bullets, powder, cartridges, caps, and wads. The last are chiefly used by hunters, and are supplied by them from anything that is convenient, which is generally something of no particular value. They therefore do not enter into commerce. From the earliest period of settlement shot and bullets have been made by Americans. Lead was brought with them from England and Holland, and cast in molds, many of which are still preserved in old houses in New England, Pennsylvania, and Virginia. They differed only in size, so whether each projectile weighed an ounce or the twentieth of an ounce, the same plan was adopted. It will readily occur to any one that these molds left a seam where the two points joined together, and that the operation of casting must necessarily have been very slow. Shot-towers, therefore, were invented at an early date, and for the sizes required for shot-guns are still necessary. The metal, a compound of lead and arsenic, the latter forming one one hundredth, is melted at the top of a high tower and poured into a colander. The lead passes through in drops instead of streams, each assuming a perfectly spherical form, and falling into a basin of cold water, there being instantly chilled in the globular form. After this the shot are rolled down an inclined plane, those which are not truly spherical falling off at the sides, while the perfect ones continue in a direct course. The holes through which the liquid metal passes are from one thirtieth to one three hundred and sixtieth of an inch in diameter. Shot is much used for killing small game, which would be torn in pieces by a heavy bullet; and a shot-gun also requires less accurate marksmanship than a rifle. Bullets are still cast in molds, but in the factories this operation is performed with great celerity. The ridge caused by the meeting of the two parts is automatically removed by a knife. Swaging of bullets is also practised. The total quantity of shot made in New York annually is valued at $400,000, there being three shot-towers. Baltimore also makes shot. Early in the last century no method was commonly known of getting accurate results from a gun, but it was noticed that a bullet was nearly always flattened or smashed at the end nearest the powder. If the ball was large for the bore of the gun it reached its mark more certainly than if the bore was large. It was therefore the common practice for hunters to put a patch or wad around their bullet, which prevented the powder from falling out, and also kept the bullet straight till it had left the muzzle; and it was also discovered that if there were grooves inside the barrel which twisted more or less, a rotary motion was imparted to the bullet, which added much to its range and its power of reaching its aim. This constituted the rifle, and after its method of construction became generally known no other weapon was used for hunting large game. They were used to some degree in armies even fifty years ago. Gradually the smooth-bore musket was driven out and soldiers were supplied alone with rifles. But another article was necessary before this could be completely accomplished. Until the second quarter of the century the fire which was required to be communicated to the powder came from a blow of the hammer of the gun upon a piece of flint. Frequently there was a miss. Percussion-caps were introduced about this time. They depended for their value upon the quality of igniting with a blow, their shape, like that of a cup, being only requisite in order to keep them on the nipple of the gun. They were much more certain in action than the flint had been, and soon drove it out everywhere. A later improvement in ammunition was by the introduction of cartridges, the powder and bullet being together. The metallic cartridge is an invention made in France about 1831 and introduced here shortly after. A great improvement was also made in France in 1845 in the shape of the bullet, which did not become known here till the time of the Crimean War. It was the Minié bullet, having for its peculiarity an elongation of the projectile. Hitherto all others had been round. The part which was foremost tapered to a point, but the rear was flat, as if the bullet had been cut from a round rod of lead. A heavier bullet was thus at-

tained, a more thorough rotation was imparted, and little resistance was experienced from the air. The new projectile would carry twice the distance of the one it superseded, and would even at that point be more destructive. The total production of ammunition in the United States in the year 1890 was valued at $6,538,482; business was carried on in 35 establishments, which had 2267 workmen, paid $1,110,482 in wages, and used materials valued at $4,645,850.

COLLARS AND CUFFS

DETACHED collars and cuffs of plain linen or cotton are, like the shirt-bosom now in use, of modern development, if not strictly of recent origin. The men of the Revolution and the first presidency wore no visible collar, but only a voluminous white cravat, wound about the neck and tied in front, the soft ends mingling with the bosom-frill of the shirt. With the new century came the high collar and extension of the shirt. Much of it was hidden by the large neck-cloth or stock; but its fashion closely resembled the cut long known to the trade as the "bishop," the upper edge rising gradually toward the front and terminating abruptly at the sides of the chin, the corners forming a slightly acute angle. This style was not uncommon thirty years ago, and a few old gentlemen still wear it. Sometimes the upper edge was turned over the cravat. Lord Byron wore his high collar in that negligée manner, and when the turned-down article was introduced as a fashion it was named after the poet, and was so designated for many years.

The plain, deep wristband, or cuff, as it is now called, came into being later than the collar. Long after the linen band had been adopted for the neck gentlemen wore lace at the wrists; but the advent of the steam-engine seems to have banished all such marks of effeminacy from the apparel of men. The deep wristband was, like the collar, an extension of the shirt, and, in further resemblance, it was sometimes turned up out of the way.

Just when the first detached collars and cuffs were made and offered for sale may not be ascertainable, but it could not have been far from a half-century ago. No doubt they were considered to be a cheap shift to avoid changing one's shirt when its exposed portions became soiled—a vulgar expedient, not in keeping with true gentility. Dickies, or false shirt-bosoms, were also used for the same reason. However that may be, they found a market; but their manufacture was small until after the invention of the sewing-machine. With the perfection of that instrument collar and cuff making on a large scale became possible and profitable.

The collar industry was started in a modest way at Troy, N. Y., by one or two men. Their success incited emulation, and several other firms entered the field. Some of the concerns now prominent in the business date back to quite near the beginning. The convenience of detachable pieces of linen was so easily apparent that the demand for them outran even the rapidly increased production. This, however, continued to enlarge, until it seemed that the limit of consumption must have been fully reached. Competition gave birth to many new fashions, and there have been several periods which might be called freakish and fantastic; but reaction to less radical forms invariably supervened.

Some English collars had long been imported, and about twelve years ago German collars were introduced. Both classes have their admirers, but there seems to be room enough for all. With occasional pauses, the development of the domestic manufacture has proceeded with great strides. Singularly enough, the business is almost confined to the city of Troy, where it started. Several of the twenty-odd firms engaged in it there have very large establishments, employ many hundred persons, and maintain warerooms in a half-dozen cities. There is no trust or combination, but the freest competition. Many grades, from fine linen to all cotton, are produced, and the workmanship in all classes has been brought to a high degree of excellence. Good wages are paid, and the industry as a whole is a fine illustration of American skill, integrity, and persistent enterprise. The value of the annual production of collars and cuffs at Troy exceeds $5,000,000, and there are one or two thriving concerns at Glens Falls, N. Y. Paper collars and cuffs, which were at one time very greatly used, now turn out an annual product valued at only $301,093, while in 1880 the production was valued at $1,582,571. Celluloid, at one time also employed, is now little used. The total production of linen collars and cuffs is not given separately in the last census report.

PRECIOUS STONES AND GEMS

THE mineral wealth of the United States so far as the so-called precious stones are concerned is only at the threshold of its development. Discoveries embracing almost the entire list of gems have been made in this country from time to time, but with few exceptions the production up to the present year has

been simply incidental to other mining operations. Among the few precious stones for which regular mines are worked the turquoise probably stands at the head in point of commercial importance, the American turquoise selling readily in the market both here and abroad. Mines in the Southwest which have been worked for some time have yielded nearly $200,000 worth of these stones in a single year. Tourmaline is another mineral which is found in sufficient crystalline purity and excellence of color to warrant its being mined systematically, although in a small way. The most important mine for this gem is in Maine, and a single crystal from these workings has brought as much as $1000. The diamond has never been found in sufficient quantity in this country to give it commercial importance, although crystals of more or less value have been discovered in Wisconsin, North Carolina, California, and Michigan. In North Carolina many important discoveries of precious stones have been made, and emeralds have been found in some quantity in Mitchell County, while certain other sections of the State are being very carefully searched, with more or less successful result, by expert miners and mineralogists. Important discoveries of rubies have also been made in this same State in Macon County, and valuable workings in the not distant future are highly probable. The sapphire has been found in Montana, of a very pure blue color, and both there and in one or two of the adjacent States crystals have been found of sufficient fineness and variety of color to cut into gems inferior only to the Oriental rubies, sapphires, and topaz. The beryl, from which the gem called aquamarine is cut, has also been found in this country to some extent. The most valuable discoveries of this crystal have been in Maine, where not only the green and blue varieties of the aquamarine have been obtained, but also the golden beryl and the clear white, both of which cut into gems of great brilliancy. Beryl has also been found in Connecticut and North Carolina. Amethystine quartz, false topaz, and cairngorm-stone are also found in considerable quantities, and garnets of more or less value may be added to the list. Opals of fine quality have been mined to some extent in Idaho. Besides these many minerals that might be classed as precious are brought to light from time to time. What the total annual production of precious stones in this country has been for the last few years is impossible to say. Specimen hunters, enthusiastic mineral collectors, and professional prospectors annually gather thousands of dollars' worth, which find their way into cabinets all over the country. In the commercial phase of the matter both producers and dealers show a marked disinclination to give figures. The report of the census of 1890 gives the total production of precious stones in the country during the ten years preceding as $851,238, which is probably far below the true amount. The United States Geological Survey gives the figures for the year 1893 as $264,041, which shows that even in that year of financial depression a marked increase took place over the average annual production of the preceding decade.

BAGS AND BAGGING

Bags, as a separate industry, have not been made for more than half a century. Originally they were put together by hand, one piece of cloth making the sides and another the bottom, if the bag was to contain much, or simply by sewing the length of the side and then across the bottom, if it was not to be of large capacity compared with its height. Various contrivances were made for the mouth. An immense number, however, are needed throughout the country, and as soon as the sewing-machine was perfected factories were fitted up to prepare them faster than had theretofore been possible. Later the bags were woven, both bottom and sides being completed, but the top hemmed by hand. The first large factory where this was done was the Stark Mills, at Manchester, N. H. Since that time many other firms and companies have engaged in this business, and it has extended to the West. There are six large manufacturers in New York, who at times turn out 100,000 bushel-bags a day, and small bags for salt and other substances amounting to twice that number. The importations from Europe average 10,000 bags daily. There are a large number made by small dealers owning a single machine, and many are made by the families of farmers residing in the vicinity of great cities. The burlaps for making bags are imported in large quantities. One of the curious subdivisions of this industry is a bag-loaning company. Shippers of goods from this country can borrow as many bags as they like, paying for the use a certain specified sum, and returning them after they are emptied. The number of establishments engaged in bag making in the United States is 64; the number of employees is 3769; the wages paid are $1,462,011; the cost of materials is $12,657,270, and the value of products is $16,355,365, very nearly twice the amount in 1880.

Bagging, which is a very important article in the South, where it is employed as a covering for cotton-bales, is also used more or less in many other

industries. The number of firms employed in its manufacture is 16; the number of hands is 3149; the wages paid are $905,213; the cost of materials used—flax, hemp, and jute—is $2,520,995; and the total out-turn is valued at $3,852,440.

Paper bags have now become very common. They are used in a thousand industries, from heavy packages like those of flour to light and graceful forms utilized in the dry-goods trade. In 1890 there were 56 paper-bag factories, employing 1382 hands, paying out $580,092 in wages, using materials valued at $3,167,717, which produced goods worth $5,023,793. The bags are made either wholly or partially by machinery. In the latter instance the cost for apparatus is a great deal less, and the labor of children and women is utilized to complete the work of the machines. Every sheet is of exactly the size needed, so there is no waste, and the pasting is done mechanically.

PAVING MATERIALS

Until a hundred or a hundred and fifty years after the first American colonies were settled there were few paved streets in our cities. Stone Street, in New York, was thus called because it was the first thoroughfare which had a pavement. This was about two hundred years ago, and the stones were probably cobbles. When the Revolution came, most of the streets in our cities were muddy from side to side in winter, including the footpaths, and in summer were mountains of dust. The first paving material largely employed in our towns was brick, which is still considerably used in Philadelphia and some other cities. This was only needed for sidewalks. The center of the street was macadamized or Telforded as long ago as sixty or eighty years, and smooth flagstones were employed in sidewalks even before that period. As time passed plank roads were laid down in many localities throughout the United States, and at one time it seemed as if all good country roads would be constructed of wood. They were much in vogue between 1840 and 1860, but have almost disappeared since. Central Park, of New York, probably furnished the first instance of the use of an asphalt roadway on a large scale. This has since been much employed, but in this climate it sometimes becomes hard in winter and cracks, and in summer becomes soft. Blocks of wood, end up, and blocks of stone, have been employed largely during the last thirty years, and have proved valuable. In Western cities artificial stone has been much used for sidewalks, being made of a beauty and evenness not found in any other material. Chicago has many miles of these sidewalks. By the last census paving and paving materials were handled by 704 firms, employing 22,730 men, and paying $10,450,970 in wages. The cost of materials used was $11,030,916, and the total output was valued at $30,644,072.

TRUNKS AND VALISES

In few industries have there been greater changes than in this occupation. Every taste may now be suited. Modern materials have been added, and frames are made of both metal and wood. In 1795 few trunks or valises were needed, as there was little traveling. The business of manufacture was then generally conducted by those who were saddlery and harness makers. In the "Business Directory" of New York in 1841 eleven names appear as trunk makers, one or two of them still being remembered. Later improvements in machinery and traveling now diminished the cost of some portions of the work materially, but not enough, on the whole, to lessen the prices of goods generally. There are five large manufactories having their offices in New York and their shops either here or near by, whose sales amount to $2,000,000 a year. In the United States there were 395 firms engaged in the manufacture of trunks and valises in 1890. They employed 6785 men, paid out $3,513,749 in wages, used $4,703,982 in the purchase of materials, and produced goods valued at $10,821,621.

LEAD-PENCILS

Lead-pencil manufacture in the United States did not begin until 1860, but there is now estimated to be $4,000,000 capital invested in the industry, and American lead-pencils are sold all over the world. This country is particularly adapted to the production of lead-pencils, for it has rich graphite mines, and extraordinary facilities, also, for obtaining this substance from elsewhere; it also has the only great forests of cedar in the world, from which the stock of the pencil is made, and even sends quantities of cedar to foreign pencil makers. Above all, it has had numbers of ingenious mechanics to originate labor-saving machinery. Germany is the pioneer country in lead-pencil manufacture, and from that nation came many of the founders of the industry in the United States. Among the first in this country were Eberhard Faber, Joseph Reckendorfer,—both of whom are dead,—and Henry Baulzheimer, who returned to Europe after opening

a factory here. New York City and vicinity have always been the seat of lead-pencil manufacture in this country, and among the prominent manufacturing firms now located there are the American Lead-Pencil Company, the Eagle Pencil Company, and the works and office of Eberhard Faber; while just across the Hudson River, in Jersey City, is the big plant of the Joseph Dixon Crucible Company, with its office and salesroom in New York. The Dixon Company was founded by Joseph Dixon at Salem, Mass., as early as 1826, and moved to Jersey City in 1840, but the company did not begin to make lead-pencils until 1872. It is the pioneer graphite company in the United States, if not in the world. The plumbago crucibles (which are identical with graphite) were invented by Joseph Dixon. Graphite now enters largely into every department of the mechanical arts. The American output of pencils is calculated to be 5000 gross per day. American lead-pencils now supply nearly all the home demand and are sold everywhere. Many novelties in pencils have originated in the United States.

ARTIFICIAL FEATHERS AND FLOWERS

Artificial feathers and flowers have long been made in the United States. It is probable that the industry was brought here by French immigrants, who had fled from their own country. The number of French people here was soon increased by those who had come hither from the island of Hayti. It was necessary that these strangers should live, and one of the first industries they took up was artificial flower making. We had at that time few greenhouses, and those which existed contributed very little to the daily supply of the citizens. But artificial flowers are permanent, lasting a year or two if required; and they serve as cheap decorations for ladies' hats and bonnets. For the same purpose feathers were used, and it became the custom to unite the two industries in the same shop. As long ago as 1840 there were ten manufacturers in this line in New York, T. Chagot apparently being the chief. He was an importer as well as a manufacturer, his place being at 24 Maiden Lane. The others were nearly all in William Street. In 1847 the number had increased to twenty-four. No separate enumeration of these products appears in the early census returns, but the quantity demanded increased greatly. Within the past few years a great change has taken place: the flowers are of a much finer quality than formerly. The importations have, usually speaking, been of a higher grade in flowers than are made here; but this is now changed, except for a few very expensive kinds, and America ranks with the world. Feathers are used on ladies' hats and bonnets, as trimming on ladies' dresses, and as boas and collars. New York is the principal seat of the industry. The amount of goods produced in the United States, including receipts from custom-work and repairing, was valued in 1880 at $4,879,-324, and in 1890 at $9,078,683. There are now 251 establishments in this line, having 6835 employees, and paying out annually $2,681,185 in wages.

DYESTUFFS AND DYEING

Almost the first industries established in the American colonies, after they were settled, and after they had taken measures to establish a food supply, were spinning and weaving, and dyeing came soon after. New dyestuffs were found here, and permanent dye-houses were established sooner than woolen factories. Butternut was a very common dye, but logwood and other substances prevented it from being used in any other than the most common work. Indigo, cochineal, annotto, quercitron, and brazil-wood were among those introduced from abroad shortly afterward, and have stayed in use up to the present time. Mordants afterward became known, and later mineral dyes. Within the lifetime of the present generation a new and exceedingly brilliant series of colors for dyeing has been evolved from coal-tar. The industry of dyeing is now very widely spread. Nearly every mill devoted to textiles has a dye-house, and there are many independent works throughout the country. In dyeing and finishing textiles there were, in 1890, 248 establishments, employing 20,267 hands, paying them $9,717,011 in wages, using materials worth $12,385,220, and turning out a total product valued at $28,900,560. Dyestuffs and extracts were made in 62 factories, employing 2302 hands, whose wages were $1,289,987, and using $6,500,928 worth of materials. The total value of the product was $9,292,514.

CORUNDUM

Corundum has been known for only a few years, and has come into popularity on account of its being harder than emery. It is used for polishing, and although it is very hard and jagged, it serves well the purpose for which it is used. The article to be polished is acted on by one wheel after another, less and less rough, until the surface becomes of a glassy smoothness. An emery-wheel is an ordinary wheel

in shape, around the circumference of which emery is impressed, glued, or pasted. Corundum is intermingled with emery, with which it is closely allied. Both are together on the same wheel. In hardness corundum is next to the diamond. Some specimens of it are the well-known gems, topaz, sapphire, and ruby. Common corundum comes from North and South Carolina and New Jersey, but some is imported. The total product is $105,000 a year.

WINDOW-SHADES

The manufacture of window-shades is a large industry in many of the cities of the Union. The extremely bright days we have in this country, together with the heat, necessitate a protection from the sun. Practically, shades are curtains, but are rolled up instead of being divided and looped up. Curtains have been known from remote times. In the "Arabian Nights" there are constant references to curtains, and in the description of the Israelite tabernacle are elaborate instructions of the way in which the curtains are to be made and looped up. In modern communities dwellings are required having windows from which light can be excluded, although admitting air. This is afforded by outside or inside shutters, or by curtains of rushes or reeds. But some forty years ago it was found that the shades or curtains then made could be rolled up on a stick, held to the right height, or pulled down when required, the power being furnished by a spring. So common has this contrivance become that almost every house is now supplied with shades moving in this way, and the manufacture of them has become a great industry. Some are moved by weights, and there are various minor contrivances. The cloths used generally imitate a brown holland. The total production is $5,812,428, the number of factories is 48, and the number of employees is 1307.

CHOCOLATE AND COCOA

The chocolate and cocoa trades of the United States have assumed vast proportions during recent years. There are 11 establishments engaged in the manufacture of various preparations from these commodities, the capital representing about $3,000,000, and furnishing employment to 963 hands. The entire product is valued at $4,221,075.

Chocolate as a beverage was introduced into Europe by the Spaniards in 1520. It is prepared from a West Indian bean. The ancient Aztecs were very skilful in making this drink, and by them it was regarded as a necessity and a delicacy. In the West Indies the product is gathered, dried, and packed for this and other markets. In the manufacture of chocolate the beans are generally roasted, and the development of a peculiar aroma indicates the completion of the process. Subsequently the beans are reduced to a paste, mixed with one half to equal parts of sugar, and a small quantity of vanilla-bean is generally used for flavoring. Chocolate is easy of adulteration, and is often diluted with farinaceous substances such as arrowroot, sago, wheaten flour, and animal fats, although the standard brands on the market are guaranteed to be chemically pure. No record is preserved of the time when the first chocolate was made in America; but in 1794 a chocolate-mill in the North End of Boston turned out twenty-five hundredweight daily. In 1829 a factory in Lynn annually made sixty tons.

Cocoa, or, more correctly, cacao, is produced by the same plant from which we get chocolate. The latter is from the kernels of the fruit of the chocolate-tree, while the former is from the nibs. Cocoa has much less fatty matter than chocolate, and is consequently preferred by many persons. In the preparation of cocoa as an article of food the aid of science has been invoked, and in the form in which it is placed on the market it is regarded as one of the most valuable food products. The statistics of this industry are included with those of chocolate.

BLACKING AND STOVE-POLISH

Shoe-blacking has long been made in this country. Fifty or seventy-five years ago gentlemen blacked their shoes as they do now, but at the earlier period it is not probable that any polishing preparation was known. Two and three centuries ago shoes were worn of the natural color, but for a couple of centuries shoemakers and tanners have made a compound containing some coloring matter which is applied to the surface of the leather handled by them. Polishing shoes probably originated either in London or Paris, and the production of blacking for this purpose has become a very extensive business in the former city. It was in a blacking factory that Dickens was employed as a boy, as he has recorded for us in the pages of "David Copperfield," although he does not there state the identity of himself with his hero. This must have been about 1821. As far back as 1841 there were seven manufacturers of blacking in New York, and there were doubtless others in Boston and Philadelphia. For fifty years a bootblack has been a necessity for every hotel in America, and there are many

boys and some men employed in this calling in the streets. Although five or ten cents is the usual price for a box of blacking, there are so many boxes sold that the business in the aggregate is a large one. The number of manufactories was, in 1890, 71. They had 1039 employees, paid out $561,644 in wages, used $1,484,203 in material, and sold $2,900,402 worth of products.

Stove-polish is plumbago, in a comminuted form, applied to stoves, and rubbed on them with a brush till they shine. Other articles are mixed with black-lead, so called, by some manufacturers, but simply for the purpose of cheapening it. Plumbago alone will accomplish the desired end. In its present form stove-polish has been known for a little over fifty years. No statistics are available on this industry, but its output probably exceeds $1,000,000 a year.

BOTTLING AND BOTTLERS' SUPPLIES

A great demand exists in all the brewing districts, and in those producing wine, for bottles, and to put up these beverages with quickness and economy requires specially trained workmen and modern appliances. Beer, wine, and spirituous liquors demand nearly all the strong, heavy bottles made in the glass factories sixty years ago, but with the temperance agitation, the inquiry for wine and beer lessened very much, and new beverages, in the shape of soda-water and root-beer, became popular. They had been known before, but those who were temperance advocates then began drinking the non-intoxicating liquids freely. An apparatus was contrived about that time by which the right quantity of fluid could be injected into bottles, the cork driven in, and the top wired; but it took many years before the invention was perfected. Much of the progress made was owing to the great springs at Saratoga, the water from which was beginning to be called for throughout the United States. Bottling was continually going on, and there were many contrivances perfected. Later mineral waters and ginger-ale were produced in quantities, each requiring separate bottles and to some extent separate devices. Much capital is invested in this business, and there is a national association composed of manufacturers. Returns are made by nearly all these firms and companies to the association, from which it appears that this industry employs nearly 30,000 persons; it serves 4,489,038 customers, owns 22,940 horses, employs a capital of nearly $51,000,000, and owns bottles to the value of $12,747,633. Its loss of bottles annually is $3,522,804. In this line are consumed annually, besides bottles, corks in great number, wire, patented arrangements for closing bottles, paper boxes for holding bottles, sealing wax, and labels. The cost of these materials is given at $7,937,001.

SCHOOL FURNITURE

Very little was made in the way of school furniture before 1850. What answered for grown people was suitable for children, so that small seats and desks were constructed by the local carpenters when needed; blackboards were prepared when used, or were dispensed with; and all the little accessories which are now a necessity in the school-room were then unknown. Threescore years ago, through a large part of the United States, the children sat upon rough planks or even upon slabs; the desks were simply boards, with a little ledge on the lower side, and there were no steel pens and very little paper. In the United States now there are over 100,000 school districts, and each school-house and each child must be supplied with facilities which were then not dreamed of. In high schools globes, orreries, and cabinets of specimens must be provided, and in all there must be a great number of contrivances to lessen labor, to make the results more uniform, and to impress more certainly the lessons to be inculcated. Much school furniture is made by those whose names are not known in that line, but the regular trade is carried on separately from that of other dealers, the estimated annual value of the business being about $15,000,000.

CORK

Cork is not a product of the United States, but is imported, chiefly from Spain. It is the bark of a species of oak. When it arrives here it is cut into smaller pieces by specially devised machinery, and is thus prepared for many uses. The chief one is for bottling. Nothing has ever been discovered that is equal to cork for this purpose, as it is very elastic, can be driven in easily, and cannot be removed without special effort. It is also employed for cork jackets, life-preservers, and buoys for nets, for which its extreme lightness makes it advantageous. The factories where these articles are produced are in the four large seaboard cities, which are chiefly engaged in the Mediterranean trade. Cork cutting is carried on in 65 factories, employing 2138 persons, to whom wages amounting to $762,518 are paid. The raw materials cost $1,501,962, and the value of the annual product is $2,840,359.

FLAGS AND BANNERS

Flags have long been produced in this country. In the early days of flag making here these emblems were made of almost any stout woven material, the stars and stripes on the national colors being sewed on separately in order to complete the design adopted. Subsequently a cloth of a homogeneous character was manufactured for the purpose, that part comprising the stripes being in one piece and the stars in another. During the war a stimulus was given to flag making, many patriotic persons being anxious to make a display of their loyalty by publicly exhibiting the national colors. There was also a large demand for flags by the armies in the field. In the early colonial days there was no standard emblem for the Americans; but with the beginning of the War of the Revolution the design of the present national colors, then composed of thirteen stars and stripes, representing the thirteen original States, was adopted. As each State was added to the Union, one star was added, until the present design, comprising forty-five stars, was completed. Thus the flags change for every decade.

At the present time New York is the center of the flag-manufacturing industry of the United States. The large quantity of bunting consumed in flag making is chiefly produced in Massachusetts. There are some concerns in New York City and Brooklyn which hire or lend flags for special occasions, and there are artists connected with the industry who decorate doorways, public and private buildings, highways, and arches.

The manufacture of banners—many of them very elaborate in design and finish, for indoor ornamentation—is also being developed. According to the census reports there were 29 firms engaged in the flag and banner business, having 364 employees, and turning out an annual product valued at $455,849.

FELT

It is probable that the making of felt preceded weaving, as many substances can be made into cloth or its equivalent simply by rubbing or shaking them together. They are interlaced by being agitated and tossed in the air, then falling upon a table with the utmost irregularity, and finally forming a thin sheet. Layer after layer is added till the required thickness is attained. Felt is used most largely for hats, but is also required for shoes and a variety of other purposes. Many improvements have been made in felt-making machinery, and the business is now very extensive. It is impossible to tell exactly the quantity of goods manufactured, as the proportion of hats made of felt cannot be ascertained. But felt goods are reported in the census as being made in 34 establishments, the value of the product being $4,654,768.

BASKETS, RATAN AND WILLOW WARE

One of the earliest industries in the East was that of basket making. No countries, except the most degraded, are without this calling, and since the settlement of America it has been carried on in all sections. Many persons are employed at it who cannot exert much physical force, and a considerable quantity of goods is manufactured in asylums and homes. Any species of willow can be used, but there are some particularly adapted to this business, as they are tougher and more flexible than others, or the trees are more accessible. The twigs are also used for many other purposes, such as baby-carriages, basket phaëtons, and seats in railway-cars. The trade does not appear so large as it really is, for much is sold by the maker direct to the consumer, and a great deal is also placed in the hands of retail men, and all this remains unclassified. There is a wider extent of usefulness for ratan goods. The raw material is obtained from the ratan palm, found in the island of Borneo and elsewhere in the East, which is imported here in vast quantities. It can be employed for nearly everything that willow can be used for, and in addition for walking-canes, hats, and many other things. There are 403 establishments now engaged in the manufacture of baskets, ratan and willow ware, employing 3732 men, and paying them $1,269,135 in wages. The raw material cost $1,398,483, and the annual value of the product was $3,633,634.

CHAPTER C

THE NEXT ONE HUNDRED YEARS

IT has been a labor of love as well as instruction to edit the articles which appear in this volume. Such a review of our remarkable century can be found nowhere else. Assistance has been sought, not among literary men and professional writers, but from the experts in each department of industry. The encyclopedia is largely professional work. This is purely practical. Gentlemen absorbed in the management of the enterprises which are the growth of the century have stepped aside from their engrossing duties and cares to put into enduring form, each for himself, a plain, clear, and lucid statement of the section of the material world with which he is familiar, and in which he has won his position, fortune, or fame. No one can rise from a perusal of these papers without having an increased admiration for the nineteenth century and unbounded hopes for the twentieth. The stories of battle and conquest, of the founding of dynasties and the dissolving of empires, of the sieges of cities and the subduing of peoples, which constitute the body of written history from the beginning of recorded time, are in ghastly contrast to this glorious, beneficent, and humanitarian picture of the achievements of the nineteenth century.

A philosopher has said that he is a benefactor of mankind who makes two blades of grass to grow where only one grew before. We celebrate harvests in inventions and discoveries where existed only Saharas. We find that the nineteenth century has not only added enormously to the productive power of the earth, but, in the happiness which has attended its creative genius, it has made the sunlight penetrate where the sunbeam was before unknown.

Our own country is peculiarly the pride of this century. It is the most complete example ever presented of the working out under favorable conditions of the principles and opportunities of civil and religious liberty. The marvelous development of the United States cannot be attributed solely or mainly to climate, to soil, to the virgin forests, or to unlimited and unoccupied territory. South America, Central America, and Mexico were as well, if not better, equipped in these respects. The garden of Eden, that fertile and fruitful portion of Asia, which for ages was the seat of empire, civilization, art, and letters, and for centuries the hive from which swarmed the conquerors of Europe, has returned to aboriginal conditions of desert and wilderness. Every industry whose birth and growth are features of this volume is the expression and witness of the beneficent principles of the freedom and liberty of individual action.

One hundred years ago the first cotton-mill was running with 250 spindles. Whitney discovered the cotton-gin, which created the wealth of the Gulf States and made the cotton industry over all the world tributary to them. Other inventors improved the machinery, and the single mill of one hundred years ago has expanded into 1000, and the 250 spindles have increased to nearly 18,000,000. One hundred and one years ago the first wool-carding machine was put in operation, under the impulse mainly of American invention. There were in 1895 2500 wool manufactories. The production of textile fabrics in this country supports 512,000 employees, paying to them in wages $176,000,000 yearly, and receives from the product $722,000,000. At the beginning of the century a few thousand tons of iron were manufactured. In 1890 the United States produced over 9,000,000 tons of pig-iron, being more than any other country; while in the manufactured products of iron and steel we are also in the advance of nations.

These astonishing figures give only the basic results of production, for from them collaterally flow car building, the miracles of the sewing-machine, of the vast employment and earnings of machinery manufacturing, of building and building materials, of the manipulation and composition of other metals, as

silver and gold and copper and brass, of the singularly rapid rise of American glass interests, of the incalculable demands made upon furnace and mill and shop for railway appliances, of the immense production of utensils useful in domestic life and in agriculture, of the great supplies of material comprehended under the name of dry-goods, and of the machinery required for the telegraph, the telephone, and the creation of electrical energy.

The twentieth century will be a truth-seeking century. The nineteenth has been one of experiment. Invention and discovery have made the last fifty years of the nineteenth century the most remarkable of recorded time. Nature has been forced to reveal her secrets, and they have been utilized for the service of man. Lightning drawn from the clouds, through the experiments of Franklin, has become the medium of instantaneous globe-circling communication through the genius of Morse, of telephonic conversation by the discoveries of Bell, and the element of illumination and motive power by the marvelous gifts of Edison. Steam, which Fulton utilized upon the water and Stephenson upon the land, has created the vast system of transportation which has given the stimulus to agricultural and manufacturing products by which millions of people have been enabled to live in comfort where thousands formerly dwelt in misery and poverty. The forces of destruction, or rather the powers of destruction, have been so developed that while the nations of the earth are prepared for war as never before, the knowledge of its possibilities for the annihilation of life and property is so great that peace generally prevails. Physical progress and material prosperity have led to better living, broader education, higher thinking, more humane principles, larger liberty, and a better appreciation in preaching and in practice of the brotherhood of man over all the globe.

The nineteenth century closes with civilization more advanced in the arts and in letters than in the best days of Greece or Rome or the Renaissance; with a development in mechanical arts, in chemistry and in its appliances, in agriculture and in manufactures, beyond the experience of all preceding centuries put together. The political, social, and productive revolutions and evolutions of the period mark it as unique, beneficent, and glorious in the story of the ages. It has been the era of emancipation from bigotry and prejudice, from class distinctions and from inequalities in law, from shackles upon the limbs and padlocks upon the lips of mankind. It has been conspicuously the century of civilization, humanity, and liberty. As its presiding and inspiring genius looks proudly over the results, he may well say to the angel of the twentieth century, "You can admire, you can follow, but whither can you lead?"

The imaginary line drawn on the thirty-first day of December, 1899, between the past and the future cannot stop the wheels of progress nor curb the steeds, instinct with the life of steam and electricity, which are to leap over this boundary in their resistless course. The twentieth century will be preëminently the period for the equitable adjustment of the mighty forces called into existence by the spirit of the nineteenth century, and which have so deranged the relations of capital and labor, of trades and occupations, of markets and commercial highways. There will come about a oneness of races and nationalities by which the moral sense of civilization will overcome the timidity of diplomacy to prevent or to punish such atrocities as are now being perpetrated in Armenia. The Turk will either adopt the laws and recognize the rights of life, liberty, and property commonly recognized among Christian nations, or his empire will be dismembered and distributed among the great powers of Europe. Militarism, which is crushing the life out of the great nations of the Continent, will break down through the burdens it imposes and the conditions it exacts. The peoples of those countries, groaning under this ever-increasing and eventually intolerable load, will revolt. They will teach their rulers that that peace is not worth the price which can only be maintained by armaments which are increased on the one side as rapidly as on the other, so that peace depends upon an equilibrium of trained soldiers and modern implements of war. They will discover closer ties of international friendship, which will strengthen year by year, and in the camaraderie of international commerce they will come to maintain amicable relations with one another before tribunals of arbitration and under the principles of justice. The world will discover, as we found in our own country in our Civil War, that a free people quickly respond to the call of patriotism to meet every requirement of war in defense of their nation, and that armies of citizen soldiers, when the danger is passed, resume at once their places in the industries of the land. The twentieth century will realize the prophecy, "They shall beat their swords into plowshares, and their spears into pruning-hooks."

The pessimist has proved with startling accuracy that with the exhaustion of fuel-supplies in the forests and in the coal-mines, the earth can no longer sup-

port its teeming populations, and that we are rushing headlong into anarchy and chaos. The twentieth century will find in the methods of the production of electrical power an economy of fuel and an increase of force which will accelerate progress and conserve our storage of supplies. Transportation both by land and by sea will be done solely by electricity. The same power will run the mills, the furnaces, and the factories. It will revolutionize and economize the processes of domestic life. It will shift and alter centers of production to places where electrical power can be more cheaply evolved, and that power will be utilized at long distances from its sources.

The hospitals of the world have reached their highest and best conditions in the nineteenth century for the care and cure of the sick and the injured. The hospitals of the twentieth century will perform this work as well, if not better, but they will also be schools of investigation and experiment. It is the peculiarity of each generation that it accepts as a matter of course that which was the astonishment and wonder of its predecessor. The antiseptic principle, which has made possible modern surgery,—the discovery of a surgeon still living,—is the commonplace of our day. So are the wonderful revelations which came through the trained brains and skilled hands of Pasteur and of Koch. Systematic and scientific research under liberal and favorable conditions will make the hospitals of the twentieth century the very sources of life. As the Gatling gun and the mitrailleuse enable the explorer in central Africa to disperse hordes of savages and open up unlimited territories for settlement and civilization, so will the leaders of the hospital laboratory produce the germicides which will destroy the living principles of consumption, of tuberculosis, of cancer, of heart, nerve, brain, and muscular troubles, and of all the now unknown and incalculable enemies which give misery and destroy life.

Continuing concentration and centralization of capital in great enterprises and in every field of production will be compelled by small margins of profit and the competition of instantaneous and world-wide communication. At the same time labor, more skilled, better educated, more thoroughly organized, finding a larger purchasing power in wages, and intelligently commanding its recognition by international compacts, will improve its condition, will find the means of quick and peaceable settlement with capital, and the relations of these two great forces will be much more beneficent and friendly.

Artists, whether with brush or chisel, or upon the lyric or dramatic stage, will require for success profounder study, broader experience, and more universal masters; but they will secure these essentials in schools at convenient centers, not only of countries, but of territorial divisions of countries. The great artist who can produce a picture which will rank with the works of Raphael or Titian and of the best exponents of modern schools will receive as adequate reward as ever for his masterpieces, and at the same time the processes of copying by the assistance of nature and chemistry will be so accurate that, with a copyright, his revenues will be increased, and his picture, perfect in every detail and expression, as well as in its general effect, and cheaply reduplicated, can be the delight, the inspiration, and the instruction of millions of homes.

Then there will be an increase in socialistic ideas and tendencies. The aim will be for a full and complete experiment of the principles of State paternalism and municipal communism. As we face the future we have no doubts as to the result, nor do we doubt that the inherent vigor of nations is greater as their institutions rest upon the liberty of the individual; yet, like the French Revolution and the theories and experiments which carried away the best thought and the highest aspirations of our own country fifty years ago, the popular tendency is for the trial of these methods of escape from ever-present poverty and misery and old-age disability. Human nature, however, has in all ages manifested itself in the social organization according to its lights and its education. Light and intelligence both accompany opportunity and experiment, and control them; and the twentieth century will close with the world better housed and better clothed, its brain and moral nature better developed, and on better lines of health and longevity. It will also exhibit increased and more general happiness, and the relations of all classes and conditions with one another will be on more humane and brotherly lines than we find them as we look back.

Let us reckon American manufactures from the infancy of the cotton and wool production in 1794 at practically zero on the one side, and on the other Europe, with the accumulated capital of over a thousand years and the accretion of the skill of all the centuries. The race-course of progress was open to the Old World and the New. Father Time kept the score, and Liberty said, "Go." To-day, after one hundred years, the American farm has become the granary of the world; the American loom and spindle and furnace and factory and mill supply the

wants of 70,000,000 people in our land, and send annually $200,000,000 in value of product abroad for other countries. Europe, pushing forward on a parallel course, finds herself outstripped at the close of the century by this infant of its beginning in agricultural production, in manufactured products, in miles of telegraph and of railway, and in every element of industrial and material production and wealth. She finds one after another of her industries leaving her to be transplanted to this country, even with the conditions of labor, which makes up ninety per cent. of the cost of all manufactures, nearly fifty per cent. in her favor. American inventive genius has cheapened the cost of production on this side of the Atlantic to the advantage of American wages, and the principles of the Declaration of Independence have done the rest. Our population has grown from 3,000,000 to 70,000,000; our accumulated wealth from less than $100,000,000 to about $70,000,000,000; the number of our farms from probably about 100,000 to nearly 5,000,000; our agricultural products from just sufficient for the support of 3,000,000 people to an annual commercial value of $4,000,000,000. The workers upon our farms have increased from about 400,000 to 9,000,000; the operatives in our factories from a handful to 5,000,000; and their earnings from a few thousand dollars to $2,300,000,000. The increase in wages has been correspondingly great. Even since 1870, it has been sixty per cent. and the purchasing power of money has enhanced about the same. Our public-school system was very crude at the beginning of the century, and the contribution of the States for its support very small. Now we spend for education annually $156,000,000, as against $124,000,000 for Great Britain, France, Germany, Austria, and Italy combined.

It is easy to see that Europe, with its overcrowded populations, its more difficult and almost insoluble problems, and with the limitations imposed upon development and opportunity by its closely peopled territories, must advance in wealth and material prosperity and the bettering of the condition of the masses by destructive revolutions or by processes which are painfully slow. The United States, with a country capable of supporting a population ten times in excess of that with which this century closes, with its transportation so perfected that it can be quickly extended as necessity may require, with its institutions so elastic that expansion strengthens instead of weakens the powers of the government and the cohesion of its States, will advance by leaps and bounds to the first place among the nations of the world, and to the leadership of that humanitarian civilization which is to be perfected by people speaking the English tongue.

Chauncey M. Depew.